CHAPTER 28

Trust, Transparency, and Technology: Blockchain and Its Relevance in the Context of the 2030 Agenda

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Introduction

In the first semester of 2020, the most widely recognized applications of blockchain technology was still bitcoin cryptocurrency. However, since its inception in 2008, blockchain has been gaining space in different areas, with the number of applications and actors increasing steadily. Its impact is already quite significant and disruptive for current business models, with potential for the whole world.

In 2017, Iansiti and Lakhani (2017) acknowledged the hype for blockchain, and how it had the potential for deep transformation of business. However, they also understood and reported the reasons why its mass adoption would take longer than expected. It will take a long time because blockchain is a foundational technology (having the potential to create new foundations for social

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and economic systems), and in order for it to work, high levels of technological, social, and regulatory complexity need to be established and coordinated. However, Iansiti and Lakhani are clear that although it will take many years, the impact blockchain will have on people, society, business, and governments is so great that the process of digital transformation had to begin straight away. In the authors' words "it will take years to transform business, but the journey begins now" (Iansiti and Lakhani 2017: 1).

Melanie Swan (2015), founder of the Institute for Blockchain Studies, explains in her book *Blockchain: Blueprint for a New Economy*, that blockchain technology can be considered the fifth disruptive computational paradigm after central computers (mainframes) in the 1970s, personal computers (PCs) in the 1980s, the internet in the 1990s, and mobile social networks in the first decade of the 2000s.

For this reason, she suggests thinking about blockchain as an advanced information technology with technical levels of escalated sophistication, with multiple applications for any form of asset registration, inventory, and exchange, including all areas of the economy, tangible and intangible assets (ideas and patents, climate change, health data, hotel reservations, contracts, etc.). In fact, all public records (such as registration of properties, civil status or car ownership, business licenses, birth and death certificates) could migrate to blockchain. Moreover, blockchain is a new organizational paradigm for discovery, valuation and transfer.

The best-known application of blockchain technology is Bitcoin, the leading cryptocurrency. Since 2013, Bitcoin, Ripple and Litecoin have been growing steadily, and in 2017, the world witnessed the first cryptocurrency boom. By December 2017, the total market capitalization of cryptocurrencies had reached the colossal peak of $6 Billion (Statista.com 2020). Just Bitcoin on its own rose its value by 2000% in the period January to December 2017

However, blockchain and Bitcoin are two different things. Blockchain is a distributed database that promotes trust and transparency and can be used to transfer all sort of things, while bitcoin is a cryptocurrency that promotes anonymity and is a device for currency transfers using blockchain technology. Bitcoin is powered by blockchain, but blockchain has many uses beyond Bitcoin (Marr 2019).

The potential benefits of blockchain technology extend to political, humanitarian, scientific, and social issues of the real world. For example, its application to the management and coordination of public data repositories and the irretrievability of transactions can be a fundamental step to advance and perhaps reconfigure different aspects of humanity. In October 2019, UNICEF announced a digital crypto fund, and the first time the United Nations became able to accept donations in digital currencies (Forbes 2019).

This has meant that both governments and local and international investors are imposing regulatory measures for cryptocurrencies. As of October 2019, several countries had developed regulations for cryptocurrencies: in countries such as Switzerland, Canada, and Mexico the use of cryptocurrencies is legal and is a generally accepted method for payments (Viens 2019). In October 2020, that Internal Revenue Service (IRS) of the United States issued guidelines on cryptocurrencies which are expected to be effective from 2020 (Forbes 2019). In this way, the introduction of regulatory mechanisms into blockchain technology and applications has become a major critical issue for developing blockchain's potential and establishing a global legal framework that includes individuals, companies, and governments by 2030.

With the changes in dynamics, actors, and relations due to these types of technologies, issues such as privacy, trust, and transparency become relevant for people and organizations. Blockchain offers protected data storage and security, as it enables privacy of information combined with a certain level of transparency, thus generating trust.

Additionally, at the United Nations conference on climate change in 2017, a group of experts let by Tom Baumann identified blockchain's potential in dealing with climate change, since it allows for greater transparency and participation of different interest groups in the search for solutions to problems associated with climate change. The open global initiative Climate Chain Coalition (CCC) (created in December 2017 and with more than 170 organizations around the world in membership by January 2020) seeks to advance blockchain technology and other digital solutions such as the internet of things and big data to support the mobilization of climate finance and improve measurement, reporting, and verification (MRV) to escalate actions for mitigation of and adaptation to climate change. This chapter is intended to contribute to the analysis of application of blockchain technology and its linkages with business transparency, trust, and sustainability. Specifically, it aims to answer the question: How does blockchain technology guarantee transparency, trust, and sustainability in the context of Agenda 2030?

The rest of this chapter is structured as follows: A description of blockchain technology is presented, followed by details of its capacity to generate trust among parties involved, as well as its characteristic transparency. Next, sustainability issues related to its implementation are discussed, and finally, some conclusions are presented to provide some insights from business practitioners and scholars.

Context and Background

Blockchain: The Technology

The paper by Satoshi Nakamoto (2008), "Bitcoin: a peer-to-peer electronic cash system," popularized the applicability of blockchain for the development of a cryptocurrency. Interest from academics, governments, investors, and users has subsequently grown exponentially. A Google Scholar search on blockchain in April 2020 resulted in more than 216,000 hits, while the same search in May 2019 revealed 55,300 publications of studies on the technology in the preceding decade.

The blockchain or chain of blocks consists of a ledger or ledgers where all operations are recorded, control over which is dispersed among different computers in a network, each of them with a copy of the chain, thus eliminating the need for confidence in just one administrator. This technology, which uses self-monitored and self-controlled algorithms, has the power to reject malicious attempts to manipulate the system.

In the first instance, blockchain was seen as a threat to traditional models of financial transactions; however, this conception has changed, since the world's biggest banks are now carrying out research and investing heavily in this innovative technology, as it is perceived as the most secure technology for financial and non-financial institutions.

Deloitte (2016) defined blockchain as a type of database that records transactions that are copied to all the computers that participate in a network. With blockchain technology, each transaction creates a block that is added to the chain, registered in a linear and chronological way with the date and time, and assigned a unique hash by the system (hash function). Blockchain effectively blocks manipulated transaction attempts and describes them with an alphanumeric string resulting from data encoding using cryptography. Hence, any attempt to falsify one of the blocks in the chain would require manipulation of the previous blocks, all of which have been registered and assigned a unique hash. This set-up guarantees the authentication, transparency, and efficiency of each transaction, and maximizes the security of the mechanism by blocking attempts to modify transactions.

Blockchain can be also defined as a distributed "database of records, or public ledger of all transactions or digital events that have been executed and shared among participating parties. Each transaction in the public ledger is verified by consensus of a majority of the participants in the system" (Crosby et al. 2016: 7). In its functioning, each transaction in the chain is transmitted to every node and it is also recorded in a public or private ledger. Each node needs to verify the ownership and identity of a block to proceed with the recording phase (Crosby et al. 2016).

Seebacher and Schuritz (2017) in an attempt to explore the concept and characteristics of blockchain, conducted a systematic literature review that allowed them to analyze a total of 31 articles and to propose a definition of the technology, which is synthesized as:

> A blockchain is a distributed database, which is shared among and agreed upon a peer-to-peer network. It consists of a linked sequence of blocks, holding time-stamped transactions that are secured by public-key cryptography and verified by the network community. Once an element is appended to the blockchain, it cannot be altered, turning a blockchain into an immutable record of past activity (Seebacher and Schuritz 2017: 14)

Additionally, Seebacher and Schuritz (2017) expose that this new technology has specific characteristics that can be listed as: trust, shared and public, low friction, peer verification, cryptography, immutability, decentralization, pseudonymity, redundancy, versatility, and automation. The most important ones are its decentralized nature and its capacity to generate trust. These two characteristics group the others in the following way: trust can be facilitated by the integrity of data, the transparency of the network, and the immutable design of the chain, which can be interpreted as the impossibility of altering the transactions that are added to every block. On the other hand, this decentralized network guarantees privacy or pseudonymity of participants, as well as reliability of information and its versatility.

Hence, combined with artificial intelligence (AI), blockchain can affect and act upon data in different ways. This combination gives deeper and more accurate data insights as blockchain can act as an access layer, whereas AI can process the data. This reveals a need for collaboration with other technologies such as machine learning or big data to achieve more computational power and improve business models.

In this sense, trusted interactions and the decentralized network constitute the core aspects of this system in any industry or application. This is translated into security and privacy issues that are also related to business sustainability. In this regard, blockchain technology may impact development-oriented investment through improvements in decentralized technologies that can benefit citizens, companies, and governments.

Blockchain and Trust

In the past, the security of information, or a physical object, depended on the capacity of someone to keep it safe. Now, this has changed (Anjum et al. 2017). Blockchain is a system that can store information in an independent and decentralized manner that goes beyond the ability of just one person or entity to provide safety. It offers trusted and secure economic transactions (Beck et al. 2016).

The relation between blockchain and trust has been analyzed since 2016. A search on Web of Science in January 2020 for articles in the categories of economics, business, business finance, and management that contain both the terms "blockchain" and "trust" resulted in a total of 48 articles (See Table 28.1).

Hence, in terms of personal data, blockchain can be used to storage or to share information in a trust-free way. This was demonstrated by Zyskind, Nathan, and Pentland (2015) in their study of a decentralized personal data management system that did not require trust in a third party.

From a network perspective, blockchain is seen as a community without hierarchy as it is run by a group of people with a common belief in a transparent and trustworthy system in which the greater the number of participants, the greater the level of trust and security among them. They can interact directly without the intervention of a third party and with a null probability of data modification (Blockchain Council 2018).

Table 28.1 Blockchain and trust

Year	*Title of article*	*Source*
2016	Fraud detections for online businesses: a perspective from blockchain technology	*Financial Innovation*
2016	Trustless computing-the what not the how	*Banking Beyond Banks and Money: A Guide to Banking Services in the Twenty-First Century*
2017	Smart contract relations in e-commerce: Legal implications of exchanges conducted on the Blockchain	*Technology Innovation Management Review*
2017	Hitching healthcare to the chain: An introduction to Blockchain Technology in the Healthcare Sector	*Technology Innovation Management Review*
2017	A Blockchain ecosystem for digital identity: Improving service delivery in Canada's public and private sectors	*Technology Innovation Management Review*
2017	The future of money and further applications of the blockchain	*Strategic Change – Briefings In Entrepreneurial Finance*
2017	Blockchain and the (re)imagining of trusts jurisprudence	*Strategic Change – Briefings In Entrepreneurial Finance*
2017	Blockchain and sensor-based reputation enforcement for the support of the reshoring of business activities	*Reshoring of Manufacturing: Drivers, Opportunities, and Challenges*
2018	Cryptocurrencies and business ethics	*Journal of Business Ethics*
2018	Blockchain and the potential of new business models: A systematic mapping	*Revista de Gestao e Projetos*
2018	Blockchain technology for providing an architecture model of decentralized personal health information	*International Journal of Engineering Business Management*
2018	Political economy of distributed capitalism (on the book by D. Tapscott and A. Tapscott, *Blockchain revolution. How the technology behind bitcoin is changing money, business, and the world*)	*Voprosy Ekonomiki*
2018	Unpacking blockchain trust	*Blockchain and the New Architecture of Trust*
2018	Blockchain as/and law	*Blockchain and the New Architecture of Trust*
2018	Trust in a viable real estate economy with disruption and blockchain	*Facilities*
2018	Blockchain: What it is, what it does, and why you probably Don't need one	*Federal Reserve Bank Of St Louis Review*
2018	The impact of financial technology on the transformation of the financial system	*Financial and Credit Activity – problems of Theory and Practice*
2018	A TISM modeling of critical success factors of blockchain-based cloud services	*Journal of Advances in Management Research*
2018	Questioning centralized organizations in a time of distributed trust	*Journal of Management Inquiry*
2018	Case study of Lykke exchange: Architecture and outlook	*Journal of Risk Finance*
2018	Business model innovation and value-creation: The triadic way	*Journal of Service Management*

(*continued*)

Table 28.1 (continued)

Year	*Title of article*	*Source*
2019	Blockchain in the IS research discipline: a discussion of terminology and concepts	*Electronic Markets*
2019	Effect of blockchain technology adoption on supply chain adaptability, agility, alignment and performance	*Management Research Review*
2019	Buyers of 'lemons': How can a blockchain platform address buyers' needs in the market for 'lemons'?	*Electronic Markets*
2019	Blockchain startups and prospectus regulation	*European Business Organization Law Review*
2019	A decentralized token economy: How blockchain and cryptocurrency can revolutionize business	*Business Horizons*
2019	Triple-entry accounting with blockchain: How far have we come?	*Accounting and Finance*
2019	Blockchain and supply chain relations: A transaction cost theory perspective	*Journal of Purchasing And Supply Chain Management*
2019	Towards a taxonomy of E-commerce: Characterizing content creator-based business models	*Technology Innovation Management Review*
2019	Blockchain technology in commercial real estate transactions	*Journal of Property Investment and Finance*
2019	Applying Blockchain to the Australian carbon market	*Economic Papers*
2019	Key success factors of Blockchain platform for micro-enterprises	*Journal of Asian Finance Economics and Business*
2019	A fair contract signing protocol with blockchain support	*Electronic Commerce Research and Applications*
2019	Information asymmetry in initial coin offerings (ICOs): Investigating the effects of multiple channel signals	*Electronic Commerce Research and Applications*
2019	Blockchain technology: Implications for operations and supply chain management	*Supply Chain Management –An International Journal*
2019	Proof-of-work blockchains and settlement finality: a functional interpretation	*Journal of Financial Market Infrastructures*
2019	Accounting and auditing at the time of Blockchain technology: A research agenda	*Australian Accounting Review*
2019	It's real, trust me! Establishing supply chain provenance using blockchain	*Business Horizons*
2019	Theory and reality of cryptocurrency governance	*Journal of Economic Issues*
2019	Toward a distributed carbon ledger for carbon emissions trading and accounting for corporate carbon management	*Journal of Emerging Technologies in Accounting*
2019	Agri-food supply chain traceability for fruit and vegetable cooperatives using Blockchain technology	*CIRIEC – Espana Revista de Economía Pública Social y Cooperativa*
2019	Benefit and risk perceived as determinants of the use of cryptocurrencies in modeling of structural equations	*Contabilidad y Negocios*
2019	Blockchains, real-time accounting, and the future of credit risk modeling	*Ledger*
2019	Energy-efficient mining on a quantum-enabled Blockchain using light	*Ledger*

(*continued*)

Table 28.1 (continued)

Year	*Title of article*	*Source*
2019	Blockchain technology and complex flow systems as opportunities for water governance innovation	*Revista Brasileira de Inovacao*
2019	Cryptocurrencies and Blockchain: Opportunities and limits of a new monetary regime	*International Journal of Political Economy*
2019	Trust, reputation and ambiguous freedoms: Financial institutions and subversive libertarians navigating blockchain, markets, and regulation	*Journal of Cultural Economy*
2019	The blockchain as a backbone of GDPR-compliant frameworks	*Quality – Access to Success*

Source: Authors' creation

The implications of this technology are also seen in the inter-organizational relations of companies from different industries who need to create reliable and trustworthy relations, as well as to guarantee security and corruption-free systems (Beck et al. 2017). This is especially important for banks or financial services companies, health care, logistics, and entertainment industries, in which blockchain appears as a fundamental and helpful tool.

As Casey and Vigna (2018) state, the importance of blockchain lies in its decentralized character in which information is not managed by a single centralized institution, but by multiple participants of the network. Moreover, as the information is grouped into blocks that are chained together, the truth cannot be changed. Here, any change requires a consensus of the total chain, making this technology an incorruptible one.

In this regard, Hawlitscheka, Notheisena, and Teubner (2018) explain the potential of blockchain technology for solving issues of trust in the sharing economy. The authors suggest that "the promise of the blockchain as a trust-free technology points at the replacement of trusted third parties such as platform intermediaries" (p. 59). In this sense, blockchain can be seen as a system that can revolutionize interactions and relations between peers who need a high degree of control and trust. It can also safeguard the cybersecurity of companies and help them overcome the infrastructure obstacles of the context.

As an example of this, Ying, Jia, and Du (2018) conducted a study on Hainan Airlines (HNA), a Chinese conglomerate that implemented blockchain technology in its e-commerce platform. The study showed that blockchain can be used to protect sensitive information, to eliminate intermediaries and enable organizations to create their own cryptocurrencies. Here "trust is not established by a central authority but rather, a crowd of nodes on the blockchain network. This approach is more reliable because it is not subject to a single point of failure" (p. 3).

In this way, blockchain technology is credited with the potential to make truly disruptive changes, since the way in which its decentralized and trusted systems and processes have application for individuals, companies, organizations, governments, and the economy. Likewise, according to Jem Bendell, professor of leadership in sustainability and founder of the Institute for Leadership and Sustainability (IFLAS) of the University of Cumbria, in England, although public opinion and the media have had fluctuating positions in favor and against blockchain, it is important to take into account the intentions and contexts in which this technology is used. Professor Bendell, who spoke at UNCTAD's World Investment Forum (WIF) on October 24, 2018, in Geneva, argues that advances or novel technological proposals will always cause intrigue and concern, and it cannot be affirmed with certainty if any technology is good or bad for humanity. However, in trying to answer a question about what the positive results are and how they can be maximized, Bendell proposed "With blockchain technology, basically data cannot be hacked." Although there are not many examples, and the technology not yet having the critical mass necessary to be adopted globally or in day-to-day activities, there is evidence of tits contribution to poverty reduction. Some examples are smart contracts, the Stellar platform in Africa, and currencies that have been created to facilitate agricultural transactions.

For Bendell (2018), blockchain has the potential to underpin the transformation of the current economic system based on debts and loans, and to transform it quickly to avoid speculators, through collective leadership that can be scaled to meet the needs of our time. In the same vein, Werbach (2018), argues that the potential of blockchain can be totally exploited only with the help of effective governance; if this does not happen, blockchain cannot guarantee trust at all. The question here is about the need for regulation but also for the potential of this system to regulate and be regulated. This leads to a call for more integration of blockchain's developers and the legal entities that are willing to implement it.

Moreover, in order to construct trust in this technology, it is necessary to convince users of its potential. The fear of fraud is present in the minds of consumers and sensitive industries such as finance and health care are still unsure of blockchain's ability to guarantee privacy and avoid fraud. The vulnerability of information can make people and companies unwilling to share their precious money and information online. But the force of blockchain's decentralized custody, execution, and settlement can persuade users to accept its security and give it their trust. Another way to build trust in this technology is to actively seek out and examine those with malign aims, such as hackers, and develop ways to be protected online (Zelbst et al. 2019).

Blockchain and Transparency

Satoshi Nakamoto (2008) introduced bitcoin cryptocurrency as a blockchain technology application; however, the vast majority of people began to hear about blockchain because of the bitcoin boom. In fact, in an HSBC bank survey in 2017, 59% of people said they had never heard of blockchain, and those who recognized this technology nearly all associated it negatively with bitcoin.

This explains the aversion of many people towards blockchain. However, its characteristic of decentralization allows parties to make transactions without intermediaries. Such transactions are more transparent than those that are made with intermediaries or centralized systems (Francisco and Swanson 2018).

The relation between blockchain and transparency has been analyzed by many authors since 2016. A search on Web of Science in January 2020 for articles within the categories of economics, business, business finance, and management that contain both the terms "blockchain" and "transparency" resulted in a total of 23 articles (see Table 28.2).

Table 28.2 Blockchain and transparency

Year	*Title*	*Source*
2017	The networked record industry: How blockchain technology could transform the record industry	*Strategic Change – Briefing in Entrepreneurial Finance*
2018	What problems will you solve with Blockchain?	*MIT Sloan Management Review*
2018	Competency-based management in a system of sustainable development of banks, financial and technology companies	*Contemporary Issues in Business And Financial Management in Eastern Europe*
2018	Trust in a viable real estate economy with disruption and blockchain	*Facilities*
2018	Case study of Lykke exchange: Architecture and outlook	*Journal of Risk Finance*
2019	Overcoming economic stagnation in low-income communities with programmable money	*Journal of Risk Finance*
2019	A decentralized token economy: How blockchain and cryptocurrency can revolutionize business	*Business Horizons*
2019	Study of factors influencing the decision to adopt the blockchain technology in real estate transactions in Kosovo	*Property Management*
2019	Triple-entry accounting with blockchain: How far have we come?	*Accounting and Finance*
2019	Blockchain technology in commercial real estate transactions	*Journal of Property Investment & Finance*
2019	Blockchain-based platforms: Decentralized infrastructures and its boundary conditions	*Technological Forecasting and Social Change*
2019	Key success factors of Blockchain platform for micro-enterprises	*Journal of Asian Finance Economics and Business*
2019	Supply chain re-engineering using blockchain technology: A case of smart contract based tracking process	*Technological Forecasting and Social Change*
2019	Accounting and auditing at the time of Blockchain technology: A research agenda	*Australian Accounting Review*
2019	Blockchain disruption and smart contracts	*Review of Financial Studies*
2019	Reengineering the audit with Blockchain and smart contracts	*Journal of Emerging Technologies In Accounting*

(*continued*)

Table 28.2 (continued)

Year	*Title*	*Source*
2019	A primer for information technology general control considerations on a private and permissioned Blockchain audit	*Current Issues in Auditing*
2019	The supply chain value of POD and PGI food products through the application of Blockchain	*Quality – Access To Success*
2019	Blockchain and smart contracting for the shareholder community	*European Business Organization Law Review*
2019	The end of "corporate' governance: Hello "platform' governance	*European Business Organization Law Review*
2019	Embedding distributed systems into organizations. How Blockchain reinforces transparency and accountability in PA's new governance models	*Social Issues in Contemporary Society: Relations Between Companies, Public Administrations, and People*
2019	Blockchain technology and complex flow systems as opportunities for water governance innovation	*Revista Brasileira de Inovacao*
2019	Blockchain and business ethics	*Business Ethics – A European Review*

Source: Authors' creation

In this vein, Changpeng "CZ" Zhao, CEO of Binance, the blockchain foundation, explains that given that transparency is the biggest advantage of blockchain, it offers the possibility of having an immutable public record of transactions and tracking them from the source to the final destination. Additionally, Nowinski and Kozma (2017) argue that blockchain technology creates value to companies in different ways; first via transaction authentication mechanisms; second, by reducing costs, since it eliminates intermediaries that were necessary for operations and transactions; third, improving operational efficiency, so decreasing waiting time. These synthesize the attraction of blockchain with its four elements: simplicity of technology, decentralization, coordination, and transparency of transactions.

Supporting this, Vanessa Grellet, the director of ConsenSys, an organization that develops blockchain technology solutions, identifies the following as priorities for the use of blockchain: Transparency in the supply chain; transparency in financing; support for human rights activism; follow-up on the impact of philanthropic donations; actions in favor of the environment and climate; trade without intermediaries; energy exchanges without intermediaries; carbon markets; and financial inclusion proposals. Similarly, for Galia Benartzi, co-founder of the cryptocurrency converter company Bancor, the biggest potential of blockchain is its transparency and impossibility of being manipulated, since anyone can see the transactions and oppose them, but nobody can manipulate them. On the other hand, Louis De Bruin, leader of Blockchain in IBM Digital Operations, stated that the biggest virtue of blockchain is its efficiency, since everything carried out under this technology is describable by the phrase "all transactions visible to everyone."

The transparency characteristic of blockchain is an asset to any type of industry. For example, in the logistics industry, it facilitates the traceability of a product through all the phases of a supply chain, at the same time avoiding negative practices within it: blockchain is a traceability and transparency guarantor. In this regard, Jeppsson and Olsson (2017) analyze the applicability of blockchain from the loading of products in a supplier's facilities until its final destination. The authors argue that this ledger allows all parties involved in the process to check the history of the product and to locate it wherever it may be. Additionally, they assert that blockchain creates transparency in the whole chain and within all participants, increases credibility, and contributes to the sustainability of the industry. However, effective use depends on cooperation between parties, motivation for its implementation, and system integration (Jeppsson and Olsson 2017).

In another area, Benchoufi and Ravaud (2017) analyze blockchain's applicability to the health industry, and more specifically to clinical trials. They found that blockchain offers a high degree of control and autonomy of data that enables it to provide historicity and inviolability. Moreover, traceability allows the creation of Smart Contracts with all the patients or stakeholders of the clinical trial. Smart Contracts enable the creation of a trusted relationship without the intervention of third parties, a feature that is lacking in present-day systems.

From a political perspective, blockchain has the potential to guarantee transparent and democratic elections; its great appeal here reflects the low credibility and confidence in the current electronic systems of voting. Here, Moura and Gomes (2017) analyze the possibility of incorporating blockchain into a digital government repertoire that will impact voter's confidence, election scrutiny, and transparency that will be reflected in improvement of societal problems, specifically of voting issues.

Likewise, the food industry can also benefit from the implementation of blockchain in the way that it can contribute to food safety and traceability, as well as waste- and cost-reduction that optimizes the supply chain. Additionally, its benefits go beyond the mere traceability of food as it allows participants to acquaint themselves with the sustainable or unsustainable ways in which food was grown (Yiannas 2017).

The applications mentioned above reveal the strength of decentralized systems due to their capability of data protection and confidentiality. Nevertheless, their privacy benefits and advantages can also represent risks for end-users. This statement is supported by De Filippi (2016) with the argument that privacy is hampered when everyone has access to all the history of a set of transactions. In practice, however, there is not a conflict between privacy and transparency as people can identify ways to preserve individual privacy in these networks.

Likewise, Akram and Bross (2018), analyzing the privacy and transparency issues of blockchain, argue for a difference in public and private blockchains. In a public blockchain there are no restrictions regarding participants and all the transactions are identified and validated publicly. On the other hand, a private blockchain involves the monitoring of permissions, which makes it less decentralized than public blockchains. Consequently, a private blockchain has more transparency as users are known and not anonymous. In this way, the degrees of privacy and transparency depend on the kind of blockchain being used.

Other relevant issues here are social and ethical considerations, as blockchain is changing the nature of cultures and organizations. Its transparency characteristic should also be reflected in its capacity to affect the consequences and risks of the system that impact the whole network.

Blockchain and Business Sustainability

Blockchain has the potential to generate societal, economic, and environmental impacts that can represent new challenges and opportunities for the digital transformation.

In this regard, the relation between blockchain and sustainability has been analyzed by many authors since 2018. A search on Web of Science in January 2020 of articles within the categories of economics, business, business finance, and management that contain both the terms "blockchain" and "sustainability" resulted in a total of only six articles (See Table 28.3).

As noted by Kewell, Adams, and Parry (2017), blockchain can be used to achieve and fulfill the sustainable development goals of the United Nations, which means it could be applied for public good. From the consumer's perspective, this technology can enhance sustainability as it provides verified information such as the origin of products in a secure and accessible platform (Nikolakis et al. 2018).

Similarly, Beck, Avital, Rossi, and Thatcher (2017) argue that this distributed ledger technology or "record of digital events" can become an enabler of social and economic transactions that will result in positive implications for organizations and societies as well as in the facilitation of value creation. Here,

Table 28.3 Blockchain and sustainability

Year	*Title*	*Source*
2018	Business model innovation and value-creation: The triadic way	*Journal of Service Management*
2019	Blockchain applications and business sustainability	*Amfiteatru Economic*
2019	Blockchain technology: Implications for operations and supply chain management	*Supply Chain Management – An International Journal*
2019	Defining supply chain management: In the past, present, and future	*Journal of Business Logistics*
2019	Biomass Blockchain as a factor of energetical sustainability development	*Entrepreneurship and Sustainability Issues*
2019	A conceptual model of sustainable supply chain management in small and medium enterprises using blockchain technology	*Cogent Economics and Finance*

Source: Authors' creation

Blockchain for Good (B4G) can deliver social, economic, and environmental positive outcomes that go beyond the simple benefits of cryptocurrencies (Adams et al. 2017).

Moreover, for the specific case of the bank industry, this disruptive technology can boost sustainable development, as it contributes for the optimization of the financial infrastructure and the use of more efficient systems; additionally, blockchain can support economic growth and green technologies' implementation (Cocco et al. 2017). Blockchain can also be analyzed from the perspective of the supply chain, exploring its potential in logistics, as was the case of the study conducted by Saberi et al. (2018), in which it appears as a tool to overcome supply chain management problems or barriers which can be categorized as inter-organizational, external, technical, or intra-organizational; this, in the end, will result in the accomplishment of acceptance of stakeholders' demands for sustainability and contributions for development as well as in a trust enhancement of different actors and avoidance of corruption.

Other arguments put forward the point that the large number of new start-ups dedicated to blockchain means that the supply of talent is not enough to meet the growing demand for blockchain developers. According to Yoav Vilner, blockchain expert and columnist at Forbes, IBM and Mastercard have submitted more than 80 patents each for blockchain-related technology, and both companies are struggling to find enough talent to develop their initiatives (Vilner, 2018).

It must be conceded that blockchain can represent a threat to climate stability and the environment as it is a resource-intensive technology that can increase greenhouse gas emissions. Applications of blockchain technology such as bitcoin require vast amounts of electricity, and this implies significant level of carbon emissions (Stoll et al. 2019). As a matter of fact, Mora et al. (2018: 931) found that that "projected Bitcoin usage, should it follow the rate of adoption of other broadly adopted technologies, could alone produce enough CO_2 emissions to push warming above 2 °C within less than three decades." Louis De Bruin from IBM noted that "blockchain energy consumption is not sustainable." The Cambridge Bitcoin Electricity Consumption Index (CBECI) (2020) estimates that by January 2020, bitcoin was using 86.74 TWh per year, more than the total annual electricity consumption of countries such as Finland, Belgium, Switzerland, Philippines, Austria Chile, or Colombia.

Blockchain's negative consequences can be reduced by the effective implementation of fiscal policies targeted at mitigating energy consumption (Truby 2018). This assumption can be interpreted in the light of the necessity for effective governance and a legal framework that will allow the achievement of meaningful goals and the development of blockchain as a tool that can be used for the reduction of waste and environmental damage for the benefit of businesses and people around the world (Sulkowski 2019). Moreover, blockchain can address different environmental challenges through three mechanisms related to resource rights, behavioral incentives, and product origins that reflect the underlying challenges of environmental management and sustainable development (Le Seve et al. 2018). On the social side, blockchain can ensure human rights and fair labor, as well as consumer confidence in transparent products.

Just as in blockchain technologies, decentralization in business sustainability requires a higher level of commitment of people as they are involved in the whole process and they are aware of the possible consequences of their acts. This can mean also higher motivation for more efficient use of natural, human, and financial resources.

The massive adoption and full development of the blockchain's potential will depend, according to Fredrik Voss, Nasdaq's vice president of Blockchain Innovation, of having a complete ecosystem. In the view of the OECD policy forum on blockchain, in order to reach its potential, it is necessary to guarantee the integrity of the processes and the creation of adequate policies and measures, and also to face the possible risks of its misuse. For this, governments and the international community will have to play a significant role in the creation of policies and the regulatory environment of the blockchain bases that are aligned with the challenges to promote transparent, fair and stable markets, as is already under way in countries such as the United States, where 28 states introduced blockchain legislation in 2019 (Morton 2019).

In this way, trust and transparency, major benefits of this technology, can be developed and provided to the business community, as no other technology has been able to do before. This immutability of information makes it even more trustworthy as every action follows a dictated protocol without the need for any intermediation by a third party. Consequently, this will be translated into major business sustainability that will help to correct redundancies, contract violations, and bottlenecks in the flow of goods.

Conclusions

The 2019 Digital Economy Report of the UNCTAD (United Nations Conference on Trade and Development) highlights the role of digital transformation in the achievement of the Sustainable Development Goals and Agenda 2030, with a focus on developing economies, while at the same time, it urges international cooperation as a tool to reach the sustainability potential of digital technologies.

In this sense, different trends in digital economies can be identified (blockchain technologies, three-dimensional printing, internet of things, 5G mobile broadband, cloud computing, automation and robotics, artificial intelligence, and data analytics).

In regard to blockchain technologies, they are referred to as "a form of distributed ledger technologies that allow multiple parties to engage in secure, trusted transactions without any intermediary. It is best known as the technology behind cryptocurrencies" (UNCTAD 2019: 6). What is important here is that by 2017, China accounted for almost 50% of patents relating to this type of technology; the United States accounted for another 25% (Chamber of Digital Commerce 2018).

This represents a call for cities and companies to adopt digitalization as a tool to create trusted and sustainable relations (Kunndu 2019). Blockchain Technologies as Distributed Ledger Technology (DLT), provides security, traceability and transparency for managerial and control issues (Saberi et al. 2018). Windolph, Harms, and Schaltegger (2014), exposed the scandal of multinational companies publishing different sustainability reports nationally and internationally in order to achieve legitimacy, success, and internal improvement. The reporting of sustainability practices is used as a tool to head off critiques of their social and environmental commitments that can affect their trade and production worldwide (Kolk 2003).

Additionally, the advantages of the digital transformation are remarkable for companies in terms of efficiency, flexibility, and sustainability (Savastano et al. 2018), for that reason, we require detailed analyses of the strategies needed to take advantages of their benefits and to overcome obstacles in the implementation process. This can also be analyzed for the implementation of sustainability practices as there is a need to measure the impact of those strategies, due to the fact that companies can implement them in order to diminish liability of origin (Park 2018).

There is a need to better understand blockchain technology, its applications and implications; for this it is necessary to exclude preconceived concepts about cryptocurrencies. According to James Zhan (2018), director of the Investment Division of the United Nations Conference on Trade and Development (UNCTAD), there are great gaps in terms of the scope and implications of blockchain that must be filled before the issuing of recommendations to those responsible for public policies, mainly in developing countries.

In terms of non-financial applications, opportunities for blockchain are increasing. This technology promises to become the engine of digital growth as it can be extended to any industry and geography in the world. Specifically, Crosby et al. (2016) identify the opportunities for the introduction of blockchain into the notary public, music, insurance, medical, and legal professions and industries, arguing that it can eliminate the need for a centralized authority that controls information.

In this sense, it is possible to argue that the role of digital transformation and its related technologies such as blockchain in implementing Agenda 2030 is gaining relevance, as it becomes a key tool guiding different interests and actors towards common goals in a quantifiable and reliable manner (Denny et al. 2017). However, it is important to highlight the need for a framework that integrates individuals, companies, and governments in a process of improvement of monitoring mechanisms that will guarantee the accomplishment of Agenda 2030's goals.

Like the achievement of the aims of Agenda 2030, and a global sustainable business environment, the wide adoption of the foundational technology of blockchain is a continuous process rather than a single endpoint. To reiterate, "It will take years to transform business, but the journey begins now" (Iansiti and Lakhani 2017: 1).

In spite of this, it also critical to understand that blockchain's environmental negative externalities need to be tackled by algorithm engineers, policymakers, and citizens. Available evidence demonstrate that the electricity consumption of this technology could have a tremendously negative impact on global temperature (Mora et al. 2018; Stoll et al. 2019; Sutherland 2019). Without addressing these environmental (and social and political associated consequences), blockchain is not sustainable (Howson 2019).

Finally, blockchain should reflect the following assumption "technologies used for digital transformation can also be leveraged to enhance trust—when they're used to enhance transparency, reinforce ethical practices, boost data privacy, and harden security" (Albinson et al. 2019).

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