Mediascapes journal 16/2020

Trust, transparency and disintermediation: an analysis of blockchain implementation in the supply-chain[*1]

Lorenzo Giannini
Università degli Studi di Urbino Carlo Bo [**]

Massimo Terenzi
Università degli Studi di Urbino Carlo Bo [***]

Blockchain represents the backbone of cryptocurrencies, their underlying technology. It can be seen as a large database shared by a peer-to-peer network of users, which collectively validates the information that is recorded on it. Not residing on a single central server, it overcomes a centralised logic, the one used by the best-known web applications like Amazon, Google or Facebook. Instead, DApps (DApp being the acronym of Decentralised Application) are distributed, decentralised applications specifically designed to run on blockchain systems. Blockchain does not involve intermediaries or trusted third parties and its main feature lies in its ability to increase transparency and traceability in transactions. A recent resolution of the European Parliament called for measures to increase the adoption of public and private blockchains, particularly in supply chain management, stating that they can have an indirect effect both at a social and economic level. Several studies have already analysed the potential of blockchain in the agri-food sector, but also in the production and distribution chain of luxury goods or other consumer goods. The existing literature focuses mainly on the role of blockchain in improving the processes related to safety and efficiency of the supply chain, yet it does not seem to problematize the concept of transparency. Despite this, the relationship between transparency and trust, which is generally confirmed by literature, is far from linear. Following an introduction of the technical characteristics of blockchain technology and its possible implementation, we address the way in which blockchain affects the issues of disintermediation, such as in the public sector, where the role of blockchain is still being defined. We also focus on the way blockchain shifts the centre of gravity of trust from an institutional, central entity, either towards the periphery or towards a technological system. Comparing the constructs of trust and transparency, we question the a priori desirability of transparency. In fact, the relationship between trust and transparency becomes rather complex in organizational communication processes. A spotlight is also placed on the aspects that affect the relationship between an organization implementing the blockchain and its relevant stakeholders, along with their different needs. We argue that blockchain still leaves a need for a relationship of trust, as much as the achievement of a trust-free model is pursued. Finally, we mention some of the major critical issues of blockchain, which are still to be resolved.

Keywords: blockchain, disintermediation, supply-chain, transparency, trust

[*] Articolo proposto il 08/06/2020. Articolo accettato il 01/08/2020
[**] lorenzo.giannini@uniurb.it
[***] m.terenzi3@campus.uniurb.it

Introduction

A blockchain is an open and distributed ledger, shared by a peer-to-peer network of users, through which the existence of a certain information is proven at a given moment of time. It does not involve intermediaries or trusted third parties, generally required to certify the regularity of the information. Being blockchain based on a peer-to-peer model, the validation of the information recorded in it overcomes a centralised logic, the one used by the best-known web applications like Amazon, Google or Facebook. A blockchain is based instead on a distributed ledger, which is a distributed database, not residing on a single central server, but on many computers connected to each other in the network. At each change, the database is updated on each of the connected peers that has the most recent copy of it. In this way, the validation on the information stored depends on the distributed consent of the users network.

Few topics on technology have had the great media resonance that cryptocurrencies have enjoyed in recent times. It is no mystery that cryptocurrencies have developed a reputation problem over the last few years. They bear the stigma of illegal activities, including illegal drug trade or money laundering, fraud, hacking, theft and other scandals (Swan, 2015). Moreover, cryptocurrencies are often questioned for their extreme volatility, as well as for fear that they could constitute a huge financial bubble (Morabito, 2017). But the shady image of cryptocurrencies could obscure the extraordinary potential of blockchain: the technology behind them.

Blockchain represents the backbone of cryptocurrencies, their underlying technology. While Bitcoin offers only one application of blockchain technology, a peer to peer electronic cash system, other blockchain-based platforms offer much more. Some blockchains allow developers to build sort of decentralised blockchain applications, called Dapps. Since these applications consist of an algorithm executed on the blockchain network, they can be used to decentralize any service controlled by a central entity. In fact, in addition to currencies, blockchain offers the possibility of representing scarce assets, such as physical goods, through the so-called non-fungible tokens, meaning that each of them is unique and not interchangeable (Chen, 2018; Westerkamp, Victor & Küpper, 2018). Hence, each physical object can be represented by a digital twin that resides on the blockchain. Thanks to these tokens, blockchain can be useful for certifying the authenticity of counterfeit risk products or protecting intellectual property (Montecchi, Plangger & Etter, 2019). There is a promising literature addressing the application of blockchain in the cultural and creative industries, from music (Baym, Swartz & Alarcon, 2019) to journalism (Ivancsics, 2019), to copyright (Savelyev, 2018) just to name a few of the more interesting works. With this paper, however, we will focus our analysis on the application of the blockchain to the supply chain. In supply chain management, some major issues that can be addressed by blockchain include abusive or risky working conditions, environmental damage and health risks due to poor supply chain management (Boucher, 2017).

A recent resolution of the European Parliament (2018b) called for measures to increase the adoption of public and private blockchains, to reduce high transaction costs and complexity in the supply chain, increase transparency and trust of participants and reduce tax evasion, corruption and money laundering. The development and implementation of blockchain in the supply chain is consistent with the typical concerns of the risk society, whereas the task of this technology seems to be the reduction of the uncertainty degree that characterizes the contemporary era.

The existing literature (Francisco & Swanson, 2018; Lucena, Binotto, Da Silva Momo & Kim, 2018; Papa, 2017; Tse, Zhang, Yang, Cheng & Mu, 2017) focuses mainly on the role of blockchain in improving the processes related to the safety and efficiency of the supply-chain. This effect is thought to be achieved primarily through its ability to improve product transparency and traceability. Moreover, it is suggested that increasing transparency and traceability in the supply chain can have an indirect effect at the social level as well as the purely economic level (European Parliament, 2018b). Apart from a relatively small number of projects in their early stages, the social potential of blockchain is still quite unexplored, there is very little literature on the subject, while the European Union itself has launched a funding programme very recently (European Commission, 2018). However, the literature does not seem to problematize the concept of transparency, nor the effects of greater transparency in the communication processes of the organizations involved. Moreover, the blockchain literature seems to rest on the idea that greater transparency always corresponds to greater trust on the part of stakeholders. In the first part of the paper we outline the technical characteristics of the blockchain and its possible implementation , as they are presented in the relevant literature. Then we address the way in which blockchain affects the issues of disintermediation, transparency and trust and the relationship between these concepts. We focus on the aspects that affect the relationship between the organization implementing the blockchain and the relevant stakeholders. Lastly, we provide indications on a number of criticalities that are to be considered in order to achieve the social effects expected from this technology.

Some technical and historical elements of the blockchain

The origins of blockchain are inextricably bound up with its mysterious inventor: Satoshi Nakamoto, a pseudonym behind which there may be one person or a group of people, of whom little if anything is known. Nakamoto theorised, a ”peer-to-peer electronic cash system” (Nakamoto, 2009, p.1) that materialised the following year as the first of the so-called cryptocurrencies: the Bitcoin. Blockchain represents the backbone of cryptocurrencies, their underlying technology. In the October 2015 edition of *The Economist* (The Economist, 2015), blockchain was defined as «the great chain of being sure about things», dedicating the cover story to this technology.

Actually, blockchain technology serves to prove that a certain piece of information exists in a given moment of time. Whatever asset can be represented with a digital identifier –

financial instruments, deeds of property, contracts, certificates/diplomas, trademarks and patents, products traced along the supply-chain – can be represented, transferred and thus circulate on the blockchain (Tapscott D. & Tapscott A., 2016). The digital identifiers, called tokens, are grouped in blocks (hence the name blockchain) and are inputted to a cryptographic function. The result of this function is a hash value – an alphanumeric value stored on the blockchain, which proves the existence of the tokens in a given moment of time. The hash function is one-way; it cannot be traversed in the reverse direction. This means that transactions registered on the blockchain cannot be falsified *a posteriori*.

We can define a blockchain as an open[2] and distributed ledger that resides in a peer-to-peer computer network, provides for secure, irreversible and transparent recording of sets of transactions in the network nodes, and involves no intermediaries or trusted third parties, typically necessary to attest to the regularity of transactions. Each block, which encapsulates a set of transactions, is literally linked up to the preceding block with two components: an hash value and a time stamp, which unequivocally indicates the time and date on which validation (or closure) of the block was made.

The definition of blockchain as an "open and distributed ledger" refers to the technology for recording the transactions that goes by the name of Distributed Ledger Technology (DLT). Blockchain is a form of DLT. A ledger is, of course, the principal book in accounting. In fact, ledgers hark back to the book entries collected in the form of archives whose origins have been traced back to 3000 in Mesopotamia (Casey & Vigna, 2018). Their function was to keep track of the exchanges of goods and services and provide a faithful, or at least hopefully accurate, representation of reality. Blockchain has, moreover, been associated with double entry accounting, invention of which has been attributed to the Italian friar and mathematician Luca Pacioli in Venice, in 1494 (Smith, 2018).

Digitalization has often favoured a centralised type of logic – the logic-based on the *central ledger*, a central database in which all the data (on, for example, monetary exchanges, transfer of property, and so forth) are filed. In this case, all the peripheral computers depend on a central computer, querying it to obtain information and updating it whenever a modification is recorded at the peripheral level.

The presence of a central ledger raises the issue of the trust that the group of associated individuals has to place in it, especially when the subject controlling the central server has, at the same time, a personal interest in the data dealt with. The best-known web applications like Amazon, Google or Facebook use centralised systems: they function on the basis of the client-server model (better known as "cloud"), in which the users link up with a central unit that manages and sorts the users' activities, as well as the flow of data exchanged within the boundaries of the application (Raval, 2016).

With the adoption of DLT, the blockchain database no longer resides in a central server but is, as the name of the technology suggests, distributed. Any change is updated on each of the connected computers, which hold the most recent copy of the blockchain. In this way, verification of the transactions is the task of all the individuals connected, while in the case of a central ledger it is up to the manager of the central database. In a distributed system, the work of the centralised system can thus be readily distributed amongst a number of nodes connected in a network. With the decentralised principle of DLT the work

of each node is independent of that of the others. In fact, blockchain can even function in the case of the individual nodes being momentarily unable to operate. Furthermore, the consensus mechanism is also decentralised.

Just as in the case of the popular applications mentioned above, there are applications specifically designed to run on blockchain systems. They are called DApps (DApp being the acronym of Decentralised Application), and they are distributed, decentralised applications. DApps operate largely through what are called *smart contracts* – pieces of code, programmed to carry out certain actions when certain conditions are triggered, as if they were clauses in a contract. Smart contracts are, in fact, "computer programs that automatically implement the terms of an agreement between parties" (Halaburda, 2018, p. 5). However, a smart contract has no need of a trusted third party since it remains permanently written into the blockchain, which implements it automatically. The contracting parties thus have the possibility to inspect the code – i.e. the rules – of the smart contract and decide whether or not to commit to implementing it. At the same time this eliminates the possibility of dispute since, the functioning of the smart contract being perfectly formalised in its code, there can be no disagreement among the parties over the results produced by the contract itself.

Given the original formulation by Nakamoto, the origins of blockchain are closely bound up with those of cryptocurrencies. The Bitcoin platform transactions are free and open to all. The underlying infrastructure is defined as *public blockchain*: its ledger has no owners. Being immune to control or restriction by any specific subject, the system is also known as *unpermissioned ledger* or *permissionless ledger.* In permissionless blockchains every participant has the faculty to add new transactions without any kind of central control. In contrast, there are other blockchains whose limits are far more sharply defined. These are *private blockchains* or *permissioned ledgers.* Private blockchains are systems entailing restrictions on access to the network and restrictions on the transactions allowed for the individual participants. The set of rules and policies governing the functioning of the transactions, agreed upon by all the actors in the blockchain, is defined at the design stage.

Fields of application of the blockchain technology

A recent Resolution of the European Parliament (2018b) identifies a range of potentialities and prospects for blockchain, through pilot projects that have so far been launched. The Resolution covers almost exclusively on assessing the potentialities and criticalities of *permissioned* blockchains within the production and distribution chain. Blockchain seems to promise higher levels of efficiency and performance from an economic standpoint: from the reduction of transport and transaction costs, to the streamlining of customs checks and regulatory compliance. Stress is also placed on the capacity of blockchain to improve transparency and traceability along the entire supply chain.

Transparency and traceability in the supply chain can have an indirect effect at the

social level as well as the purely economic level, as the following extract points out:

> "blockchain has the potential to support the TSD [Trade and Sustainable Development] agenda by providing trust in the provenance of raw materials and goods, transparent production processes and supply chains, and in their compliance with international rules in the field of labour, social and environmental rights, considering the particular relevance to conflict minerals, illicit trade in cultural goods, exports control and corruption; […] blockchain could contribute to the sustainability work of companies and promote responsible business conduct" (p. 4).

This passage also covers another area for which blockchain is considered able to play a major role, namely the fight against illegal practices, from tax evasion to elusion, and from trade-based money laundering to the use of counterfeit goods and fake documents. Schatsky and Muraskin for Deloitte (2015), one of the oldest and largest auditing and advisory companies in the world, set out to explore the ways in which blockchain may affect the various economic sectors in the near future. According to the authors, together with its reliable, immutable, irrevocable and digital characteristics, a major strong point shown by blockchain lies in its transparency. By transparency here we mean the possibility to render transactions visible for the participants, consequently enhancing auditability and trust.

Analysing the use of blockchain in improving the transparency of the supply chain, several studies have already analysed the potential of the application of blockchain in the agri-food sector (Francisco & Swanson, 2018), possibly improving the traceability processes of food (Papa, 2017), its safety (Tse et al., 2017) and overall quality (Lucena et al., 2018). Some pilot projects have taken steps in this direction, starting from two case studies involving IBM, in collaboration with Walmart, with the aim of tracing the movement of pork in China (Hackett, 2016), as well as with a series of important retailers (including Nestlé and Unilever to name a few); the main goal being strengthening consumer confidence by tackling the problem of food contamination (Aitken, 2017). Other interesting projects have been developed to improve the traceability in the supply chain of tuna (Provenance, 2016a; 2016b) or coconut (Provenance, 2017) in South-East Asia.

A study by the University of Stanford (Galen et al., 2018) analyses the development of blockchain projects for the social good. According to the authors, the most promising areas appear to have been those concerning governance and non-profit organisations; ideally, in these areas there should be synergies between the public sector and the actors in the private sector that are investing energy and resources into development of the technology. The study classifies blockchain projects according to the various application sectors: agriculture, democracy and governance, digital identity, energy, climate and environment, financial inclusion, health, land rights, philanthropy and a number of other sectors including education, human rights and water. Although most of the projects are still in the early or pilot stages of development, it is estimated that over half of them can be showing the first results by the end of 2019. Of these projects: "66% say blockchain is an improvement over other methods of solving their problem. 20% say blockchain is a necessity for solving their problem" (p. 3).

As an example, the projects regarding agriculture should have the potential to impact on

the conditions of great numbers of people. 90% of these investments are made by European, Australian and American organisations, 50% finding implementation in the same countries. However, a good 30% of the implementations are carried out in sub-Saharan Africa. It has been estimated that 13% of these projects could reach out to over a million beneficiaries, although most of the projects have been in place for less than two years and none of them impact on more than 1000 persons. The aim of these applications is to settle some of the problems in the agricultural supply chains, where the data on compliance, safety, sustainability and product certification are filed in proprietary databases, and often on paper. Apart from the considerable operating costs, evidence has emerged of risks of fraud, corruption and human or instrumental errors. To limit the risks of fraud and contamination, and indeed to enhance the transparency, traceability and efficiency of the supply chain, the commercial operators in the agri-food sector are shifting 60% of the applications onto blockchains (p. 12). The challenges arising in the sector concern the willingness of the various actors in the supply chain to adopt blockchain, development of an adequate digital literacy, and sufficiently widespread availability of Internet and connections to support the technology. Of course, deficiencies in the latter two factors could hamper adoption of blockchain in rural areas.

The array of products that can potentially benefit from application of blockchain to the supply chain seems fairly vast, and indeed experimentation ranges from the upmarket sector of expensive collectibles, including fine art, antiques and jewellery, to commodities of everyday use or staple goods like textiles and foodstuffs. Boucher (2017) argues that tracing the provenance of diamonds, from the mines to the jewellers' shops offers the stakeholders, and in particular the customers, the opportunity to make purchases fully aware of the events involved in the relevant production and distribution chains. In the case of diamonds, for example, this could amount to guarantee that the goods are not fake, that no forced labour has been employed and that the intermediaries and sellers have not been implicated in drug or arms trafficking. In the field of foodstuffs, it would be possible to have details on how the food has been grown, raised or prepared, and who has been responsible for inspection. Moreover, it would also be possible to ascertain the working conditions of those involved and the respect of ethical standards.

Montecchi et al. (2019) underline how establishing the origin of products becomes increasingly challenging as supply chains themselves become increasingly complex. For example, in the market of luxury products it is becoming more and more difficult to distinguish fakes, also because the forgery market is expanding on a vast scale, in particular along the channels of online distribution. In this market, assuring customers that the products are genuine is fundamental to reduce the perception of psychological and social risk, i.e. the risk of a purchase that is not backed by respect of ethical criteria, and the desire to avoid the social stigma that comes with the – willing or unwilling – purchase of a forged product.

Blockchain, disintermediation processes and trust

Concerns about the complexity of the contemporary supply-chain are consistent with the theoretical framework of the risk society (Beck, 1992; Giddens, 1990). As is known, in this interpretative model, trust is considered an indispensable resource to deal with a social organization characterised by high levels of complexity, uncertainty and risk (Luhmann, 1979). The opacity of an increasing number of segments of the social world, the impersonal character of the subjects taking part in it, the extreme character of the division of labour and interdependence that characterize advanced modernity, are typical elements of the risk society (Seligman 1997). A concept of blockchain as a technological device that can play a role in encouraging transparency in the supply chain and consequently acting on trust is consistent with this interpretative framework and the necessary conclusions must be drawn from it.

Boucher (2017), while admitting that the role of blockchain in the public sector has yet to be defined, attempts to understand the ways in which this technology can lead to rethinking public services. Apart from the field of e-voting, where some experimentation has come under way, the most interesting developments lie in the direction of record-keeping in public administrations, land registers, birth certificates and commercial licences, to name but a few. In such cases a blockchain can act as an incentive to disintermediation processes, contributing to a scenario where such mediator figures as lawyers, notaries and government officials lose centrality:

> "for each transaction that uses a distributed ledger instead of a traditional centralised system, the intermediaries and mediators are displaced, missing out on their usual source of power and income. For currencies these are the banks, for patents the patent office, for elections the electoral commissions, for smart contracts the executors, and for public services the state authorities" (Boucher, 2017, p. 22).

The role of blockchain in triggering disintermediation appears even more relevant in its *unpermissioned* version, but while the European Parliament Resolution (European Parliament, 2018b) focuses entirely on permissioned blockchains, unpermissioned blockchains are mentioned only with regard to the risks associated with their use. For instance, possible criminal activities they might incentivise, such as tax evasion and trade-based money laundering.

Boucher also raises the question of the values embedded in the technology. All technologies promote (or may promote) values (Flanagan, Howe & Nissenbaum 2008). The use of a traditional centralised ledger places its creators in a central position – a position of mediation of all the transactions that go through the ledger. Every transaction reaffirms and reproduces the central, indispensable role of the owner of the ledger. On the other side, "blockchain-based applications often appear to be wedded to discontent with traditional systems, processes and mediators" (Boucher, 2017, p. 23). Therefore, using a distributed ledger means – in particular in the case of permissionless blockchains – participating in a broader social change that sees a decline in the trust placed in classical institutions, like banks and governments, as well as their power. The decline in trust is a

historical-social fact regardless of blockchain (Ries, 2019), preceding its development but possibly holding important implications for its future and some blockchain projects would promote the elusion of traditional centralised authorities and institutions and show similarities with sharing economy (Boucher, 2017).

In their recent literature review, Hawlitschek, Notheisen and Teubner (2018) address the issue of trust in intermediaries in systems based on interactions, where high degrees of trust are required, such as in the platform driven sharing economy. In this context, at least potentially, blockchain facilitates value exchange mechanisms without any need of the mediation of a third party, aiming at taking the place of whatever institution or a proprietary platform would be traditionally involved. The authors explain how blockchains make obsolete by design any costly mechanism serving to create trust in intermediaries or confidence at the interpersonal level, in particular with smart contracts and the possibility they offer to implement contractual agreements and other applications. Blockchain is defined as a potentially trust-free technology. In a trust-free system, transactions are implemented counting not on the reliability of a third party, but on the distributed reliability based on the network consensus (i.e. blockchain users).

Their review offers two main ideas worth to be considered. Although blockchain technology can supersede the issue of trust in platform providers, the issue itself does not disappear, but shifts in the direction of the algorithms. Boucher (2017) argues similarly that a distributed ledger implies confidence in the encrypting and networking technologies. Hawlitschek et al. (2018) also add that “blockchain technology in and by itself is not able to provide an environment that renders trust-building outside the closed blockchain ecosystem obsolete” (p. 59). In fact, institutional factors and pre-existing relations of trust still retain their relevance. Boucher (2017) emphasizes on the same dynamics but from a different angle, as he states that in a supply-chain trust amongst the participants cannot exist without a pre-existing trust in blockchain, especially considering the vulnerability of the platform itself, exposed to both accidental errors and malicious attacks.

These conclusions are consistent with the theoretical framework of the risk society. Namely, there is a bet of trust being placed by the truster on the trustee (Sztompka, 1999) even when a technological system replaces any other form of mediation, be it an institution, an organization or a company. From this point of view, only the target of trust changes. Unless one has full control over others' behaviour (through forms of coercive or manipulative power), she/he actually enters the domain of trust, by its nature characterised by an ineliminable degree of opacity.

Blockchain, transparency and trust

Outside the sphere of full control is the sphere of opacity and trust. The promise of blockchain is not only to increase transparency (i.e. to dissipate opacity) but to restore a form of full control. However, this promise is not feasible, because blockchain cannot create a trust-free environment. The trust of the involved parties must be placed either in

the blockchain itself, or in the power of the algorithms or in the organization that uses it. The interest in the implementation of blockchain focuses (cfr. 3.1) on its ability to make the supply chain transparent and traceable. However, we lean to argue that often these evaluations do not problematize the concept of transparency, nor the impact of transparency in communication processes that affect companies and organizations.

In the field of the social sciences transparency is seen as a means to achieve desirable social ends, but there is poor consensus on what exactly this entails, apart from general agreement on the idea that information is a necessary condition for it. The concept calls into play a variety of ideals and expectations, from increased visibility and efficiency to accountability, authenticity, participation, involvement, empowerment, emancipation, and trust; having reference to a vast range of objects, uses, technologies and practices, transparency entails certain difficulties for theorisation (Hansen, Christensen & Flyverbom, 2015).

As pointed out by Garsten and De Montoya (2008), the communication processes of enterprises are characterised by constant attention to the distinction between what is to be shown (to comply with regulatory obligations or to work on construction of the brand identity) and what is to be kept hidden. While high levels of transparency may be desirable for the stakeholders, this is by no means a natural outcome of the enterprise culture. “An important part of organizational life consists of handling information in a way that balances secrecy and confidentiality with openness and sharing” (p. 81). Disclosure of certain information, not only on the development of new prototypes or products being patented, but also on the suppliers, prices or other information deemed key, can to some extent compromise the competitive advantage gained by an enterprise. Indeed, it is a fairly common practice to draw up agreements on confidentiality which suppliers or employees are required to undersign on being taken on. Schnackenberg and Tomlinson (2014) also stress how organisations exercise certain discretionary powers in circulating information, which results in varying degrees of transparency. In most cases, according to Mayer (2012), any tightening of the regulations applying to firms to promote ethical behaviours is met with attempts at getting round it, or with higher costs potentially transferred to the customers. According to anthropologist Marilyn Strathern (2000), today many firms are victims of the “tyranny of transparency” – the mechanism by which organisations are not obliged by law but forced by the pressure of the media or public opinion to embrace this idea of “transparency at all costs”. The analysis by Garsten and De Montoya (2008) confirms that increasing transparency may entail an increase in purely economic costs, due to the data stream the firms have to produce for the purpose.

A correct interpretation of the meaning of transparency in the supply chain cannot fail to take into consideration stakeholders. In this connection, Schnackenberg and Tomlinson (2014) reviewed the literature on transparency to ascertain which dimensions contribute to transparency and its role in the development of trust between an organisation and its stakeholders. While scholars show general agreement on the role of transparency in creating trust, maintaining it or remedying situations that see it compromised, the authors hold that this relationship has never been explored at the theoretical level. Their work provides us with a more complex concept of transparency:

> "transparency appears to be a function of three theoretically viable and managerially relevant factors: disclosure, clarity, and accuracy. Disclosure is increased as stakeholders perceive information as more relevant and timely; clarity is increased as stakeholders perceive information as more understandable; and accuracy is increased as stakeholders perceive information as more reliable" (p. 12).

This concept of transparency focuses on the perception of stakeholders regarding the quality of information made available by the organization. Do stakeholders perceive that information is promptly received and easy to obtain? Do they feel like the firm perseveres in the direction of disclosure despite possible risks? Is information perceived as comprehensible?

While blockchain affordances (cfr. par. 2) can satisfy these needs, shifting the focus from transparency for its own sake to transparency as stakeholders perception of the quality of information, leads to taking into account a number of other factors such as blockchain diffusion, the spread of blockchain literacy, the different organizational cultures and how much stakeholders perceive the blockchain itself as reliable. Arguing along these lines, Mougayar (2016) points out that blockchain needs an ecosystem populated by a sufficient number of users. At the moment, the infrastructure is unevenly distributed, if not actually inaccessible to the average user, given the advanced skills required together with a grounding in ICT language.

The blockchain literature seems to rest on the idea that greater transparency always corresponds to greater trust on the part of stakeholders. Some time has passed since Tapscott and Ticoll (2003)[3] defined transparency as an attitude of active openness, crucial for consolidating confidence amongst the major stakeholders, in particular as regards the information that concerns them more closely. Furthermore, in the model presented by Schnackenberg and Tomlinson, the relation between transparency and trust is not linear but mediated by the perceived trustworthiness of the organization. Here, transparency is seen as the precursor of an organisation's perceived trustworthiness, or from another point of view, trustworthiness is seen as the mechanism that catalyses the effect of transparency on trust. To define trustworthiness, the authors turn to the model presented by Mayer et al. (1995), according to which stakeholders consider the organization as trustworthy to the extent that it has a set of competencies by virtue of which it can exert an influence in a certain area (*ability*); to the extent that the organization, as a trustee, is believed to want to do good to the trustor, aside from an egocentric profit motive (*benevolence*) and to the extent that it adheres to a set of values/principles considered acceptable by the stakeholders (*integrity*).

Relying on this model, we believe that the role of blockchain in enhancing perceived trustworthiness depends on its ability in promoting benevolence and integrity, which means, respectively, to represent the good intentions of the organization and the values to which it adheres. Significantly, Sztompka (1999) distinguishes the trustee's expectations based on the probability that these expectations will be met. In his interpretative scheme, the expectation of benevolence and generosity is the one that has the least probability of being satisfied and therefore represents the riskiest bet of trust.[4]

Conclusions

In this article we have tried to shed light in the emerging role of blockchain technology in supply-chain management, its most relevant areas of application and the hopes that are placed on the potential of this technology. The existing literature (cfr. par. 3.1) focuses mainly on the role of blockchain in improving the processes related to the safety and efficiency of the supply-chain and, while its possible social implications are also suggested, the projects launched are still few in number and little investigated. The field that has so far been explored with relatively advanced and interesting findings is that of the agricultural supply-chain, with projects having impact on generally small-scale activities and communities. On the basis of our analysis of the literature, we believe that the conceptual poles around which to proceed with further considerations (and that can represent a framework for further analysis on the subject) lie in disintermediation, trust and transparency, and the way these elements interrelate.

The disintermediation processes enabled by blockchain raise the issue of trust. Despite the possibilities blockchain offers to replace the intermediaries, to leave privileged positions behind and shift power from the centre towards the peripheries, a series of aspects emerges from our analysis that are to be borne in mind for future analyses. All technologies promote (or may promote) values (Boucher 2017; Flanagan, Howe & Nissenbaum, 2008) and the implementation of the blockchain may thus ride the wave of widespread diffidence towards the institutions, as indeed towards expert knowledge and the various forms of mediation; a sense of distrust that enjoys a certain social consensus in this point in our history. However, it must be recognised that blockchain is not (at least for now) able to provide an environment that renders trust-building outside its ecosystem obsolete. It is still needed an institutional contact person to guarantee the correct functioning of the technology (to monitor the aspects of the technology that still present some criticalities). Moreover, as has been argued in Galen et al. (2018), the most promising areas for application of blockchain appear to be those related to governance and non-profit organisations. In these cases, it is pointed out, it would be desirable to find synergies between the public sector and the actors in the private sector (European Parliament, 2018a). Some articles emphasised that there is a need for a relationship of trust, between the parties involved, that precedes the use of technology or trust in blockchain itself. In conclusion, they observe, even in the cases achievement of a trust-free model is pursued, the issue of trust does not disappear completely, but rather shifts towards the trust the users must necessarily place in the algorithms.

The blockchain literature seems to rest on the idea that greater transparency always corresponds to greater trust on the part of stakeholders. This axiom appears to be reflected in the role that is generally attributed to blockchain when it is interpreted as a mere mechanism to raise the level of transparency in trade relations, but the effects of blockchain do not boil down to mere increase in transparency. The analysis conducted so far suggests two reflections. In the first place, in the case of application of blockchain to

the supply-chain the relationship between transparency and trust that emerges from the literature is far from linear. From an entrepreneurial perspective if it's true that setting off on the road to blockchain is taking a step towards greater transparency, at the same time there is a narrowing of the discretionary margins within which the firm can handle the information that may help it to a competitive advantage in its sector of the market. Enhancing the transparency of transactions, supplying more information to consumers on the supply-chain per se, does not suffice for them to place more trust in the firm. This may mean a greater resistance on the part of the firm to embark upon strategies in the supply-chain based on blockchain, and thus a limitation of the positive social effects that this technology can have. Any analysis of application of blockchain to the supply-chain will necessarily take into account the use firms make of blockchain if the aim is to achieve a positive effect at the social and community level. From a stakeholders perspective enhancing the transparency of transactions, supplying more information to consumers on the supply-chain per se, does not suffice for them to place more trust in the firm. For consumers, the link between the provenance and value of a good is primarily symbolic and only secondarily factual (Montecchi et al., 2019). This places blockchain amongst the tools relevant to practices of responsible consumption and prosumption: the effect on the communities concerned is obtained only when the consumers have shown an interest in it.

As regards the relationship between transparency and trust, applying the Schnackenberg and Tomlinson (2014) model to blockchain, it emerges that blockchain can in fact raise the trust that the stakeholders place in it, acting on the perceived quality of information and on the characteristics attributed to the organisation, but this in particular is the case if the technology is at work in a context where the values it incorporates are shared, an economic and cultural context in which knowledge and understanding of the technology are sufficiently widespread, together with the relevant technology literacy.

The Edelman Group, one of the biggest communication and marketing agencies in the world, has since 2001 been publishing the *Trust Barometer,* surveying the trust placed by the public in the media, in information in the broad sense, and in enterprises (Edelman, 2018). A poll was submitted to a subsample of the informed public on matters concerning new technologies. Among the various technological innovations on which the opinions of the interviewees were sought is blockchain. The participants were asked how much trust they had in companies that adopt blockchain technology. What emerges is that trust in companies using blockchain appears to be positively affected by the support of three factors: a) new regulatory steps taken in their respective countries; b) the development of pilot projects; c) favourable attitudes stated by the institutions.

Reference here is to permissioned blockchains (used in particular in electoral systems) where a central authority, preferably of the state, keeps control over certain aspects of management of the platform. In this case the levels of decentralisation and transparency are reduced, and their cultural and political implications weakened. This takes us back to the distinction between permissioned and unpermissioned blockchains. The most significant impact of blockchain so far, according to Boucher (2017), has been observed with applications that have relatively little to do with the essentially idealistic views of the

technology, which count decentralisation and transparency among its most advantageous features.

Besides the criticalities so far considered here, it is worth noting in conclusion some further stumbling blocks that lie along on the path to development and dissemination of blockchain. From the environmental point of view, application of blockchain entails considerable carbon emissions and the production of electronic waste (Tapscott & Tapscott, 2016); applied on a significantly larger scale it could raise an energy issue (Boucher, 2017). Secondly, blockchain involves some issues regarding conformity with standards of privacy and data protection. The permanent, immutable nature of the technology could imply a risk for data protection and confidentiality. Indeed, the possibility of conflict with the "right to be forgotten" has been evoked, proportionately increasing to the extent that the data conserved are of a personal nature and the person referred to may be readily identified. With sufficient effort, in fact, it is possible to connect the transactions with the specific parties (Boucher 2017). Finally – and this, perhaps, is the major drawback – there remains the problem of verifying respect of the right standards. The ledger can record the date and details of the transaction, but it cannot verify the accuracy of what is described there. The problem lies in the transformation of physical entities into blockchain objects, or in other words representation of them in the form of digital twins. Theoretically, it is sufficient for the data fed into the system to conform with the technical requisites demanded by the algorithm to become real on the blockchain, regardless of the truthfulness of their contents. Thus, the need is to ensure adequate verification at the delicate stage when the data are first inserted. This implies reintroducing an element of centralization in the decentralised model, which cannot be avoided. That is, the discretionary power attributed to those who fed data (or oversee the data fed), can only be limited, but not seized, by the blockchain algorithm. The issue has to some extent been discussed in the literature, leading to the conclusion that certain processes cannot as yet be held to replace the gatekeeping role of the civil servants.

Biographical notes

Lorenzo Giannini is researcher at the Department of Communication Sciences, Humanities and International Studies: History, Cultures, Languages, Literatures, Arts, Media at the University of Urbino Carlo Bo. He has carried out research mainly in the field of sociology of culture and sociology of consumption. Among his most recent publications: "Includere marginalizzando. Etnografia del volontariato in una Festa de l'Unità a Bologna" in *Polis, Ricerche e studi su società e politica*, 2/2018; and "Repair Events and the Fixer Movements: Fixing the World One Repair at a Time", in A.Day (ed.) (2017) *DIY Utopia. Cultural Imagination and the Remaking of the Possible*, Lanham, MD: Rowman and Littlefield.

Massimo Terenzi is graduated with a Master's Degree in Communication Studies from the University of Urbino, with a Bachelor's thesis titled "La blockchain per le imprese: la sfida della trasparenza nella Corporate Social Responsibility" and a Master's thesis titled "Il ruolo dell'OSINT nel monitoraggio di fake news e media manipulation".

References

Aitken, R. (2017). IBM Forges Blockchain Collaboration With Nestlé & Walmart In Global Food Safety. *Forbes*: Taken from: https://www.forbes.com/sites/rogeraitken/2017/08/22/ibm-forges-blockchain-collaboration-with-nestle-walmart-for-global-food-safety/#27c078c23d36

Baym, N., Swartz, L., & Alarcon, A. (2019). Convening Technologies: Blockchain and the Music Industry. *International Journal of Communication*, 13, 402–421. Taken from: https://ijoc.org/index.php/ijoc/article/view/8590

Beck, U. (1992). *Risk Society*, London: Sage.

Boucher, P. (2017). How Blockchain Technology Could Change our Lives. *European Parliamentary Research Service, Scientific Foresight Unit*: Taken from: http://www.europarl.europa.eu/RegData/etudes/IDAN/2017/581948/EPRS_IDA(2017)581948_EN.pdf ,

Casey M. J., & Vigna, P. (2018). *The Truth Machine*, New York, NY: St. Martin's Press

Chen, Y. (2018). Blockchain tokens and the potential democratization of entrepreneurship and innovation. *Business Horizons*, 61(4), 567-575. doi.org/10.1016/j.bushor.2018.03.006

Edelman (2018). 2018 Edelman Trust Barometer. *Edelman*: Taken from: https://www.edelman.com/sites/g/files/aatuss191/files/2018-10/2018_Edelman_Trust_Barometer_Global_Report_FEB.pdf

European Commission (2018). EIC Horizon Prize on Blockchains for Social Good. Retrieved June 2nd, 2020: Taken from https://ec.europa.eu/research/participants/data/ref/h2020/other/prizes/contest_at/h2020-prizes-rules-bc-social-good_en.pdf

European Parliament (2018a). Distributed ledger technologies and blockchains: building trust with disintermediation: Taken from: http://www.europarl.europa.eu/doceo/document/TA-8-2018-0373_EN.pdf

European Parliament (2018b). Blockchain: a forward-looking trade policy: Taken from: http://www.europarl.europa.eu/doceo/document/TA-8-2018-0528_EN.pdf

Flanagan, M., Howe, D.C., & Nissenbaum, H. (2008). Embodying values in technology. Theory and practice. In J. Van den Hoven & J. Weckert (eds.), *Information technology and moral philosophy* (pp. 322-353). New York: Cambridge University Press.

Francisco, K., & Swanson, D. (2018) The Supply Chain Has No Clothes: Technology Adoption of Blockchain for Supply Chain Transparency. *Logistics*, vol. 2, 2. doi:10.3390/logistics2010002

Galen, D., Brand, N., Boucherle, L., Davis, R., Do, N., El-Baz, B., Kimura, I., Wharton, K., & Lee J. (2018). Blockchain for social impact. Moving beyond the hype. *Center for Social Innovation, RippleWorks*, Stanford Graduate School of Business: Taken from: https://www.gsb.stanford.edu/sites/gsb/files/publication-pdf/study-blockchain-impact-moving-beyond-hype_0.pdf

Garsten, C., & De Montoya, M. L. (2008). The naked corporation: visualization, veiling and the ethico-politics of organizational transparency. In C. Garsten & M. L. De Montoya (eds.), *Transparency in a New Global Order* (pp. 79-93). Cheltenham: Edward Elgar.

Giddens, A. (1990). *The Consequences of modernity*. Cambridge, England: Polity Press.

Hackett, R. (2016). Walmart and IBM Are Partnering to Put Chinese Pork on a Blockchain. *Fortune*: Taken from: https://fortune.com/2016/10/19/walmart-ibm-blockchain-china-pork/

Halaburda, H. (2018). Blockchain revolution without the blockchain?. *Communications of the ACM*, 61(7), 27-29. doi.org/10.1145/3225619

Hansen, H. K., Christensen, L.T., & Flyverbom, M. (2015) Introduction: Logics of transparency in late modernity: Paradoxes, mediation and governance. *European Journal of Social Theory*, 18(2), 117–131. doi.org/10.1177/1368431014555254

Hawlitschek, F., Notheisen, B., & Teubner, T. (2018). The limits of trust-free systems: A literature review on blockchain technology and trust in the sharing economy. *Electronic Commerce Research and Applications*, 29, 50-63. doi.org/10.1016/j.elerap.2018.03.005

Ivancsics, B. (2019). *Blockchain in Journalism*. Tow Center for Digital Journalism. New York, NY: Columbia Journalism School. https://doi.org/10.7916/d8-5jm6-w328

Lucena, P., Binotto, A. P. D., Da Silva Momo, F., & Kim, H. (2018) A Case Study for Grain Quality Assurance Tracking based on a Blockchain Business Network. *FAB 2018. Symposium on Foundations and Applications of Blockchain*: Taken from: https://arxiv.org/pdf/1803.07877

Luhmann, N. (1979), *Trust and Power*, New York, NY: John Wiley.

Mayer, C. (2012). *Firm Commitment: Why the Corporation is Failing Us and how to Restore Trust in it*. Oxford: Oxford University Press

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An Integrative Model of Organizational Trust. *Academy of Management Review*, 20, 709-734. doi.org/10.5465/amr.1995.9508080335.

Montecchi, M., Plangger, K., & Etter M. (2019). It's Real, Trust Me! Establishing Supply Chain Provenance Using Blockchain. *Business Horizons*, 62(3), 283-293.cdoi.org/10.1016/j.bushor.2019.01.008

Morabito, V. (2017). *Business Innovation through Blockchain*, Cham: Springer.

Mougayar, W. (2016). The Business Blockchain. Promise, Practice, and Application of the Next Internet Technology. Hoboken, NJ: John Wiley & Sons.

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

Papa, S. F. (2017). Use of Blockchain Technology in Agribusiness: Transparency and Monitoring in Agricultural Trade. *Advances in Economics, Business and Management Research,* 31, 38-40. doi.org/10.2991/msmi-17.2017.9

Provenance (2016a). The first fish on the blockchain: connecting fisherman, global retailer and consumer. *Provenance*: Taken from: https://www.dropbox.com/sh/eshn8mg3pxbtj2y/AACI414CZJi4VrXBIkIONegEa/Tun

a%20Traceability%20Pilot?dl=0&preview=Tuna+Traceability+Press+Release.pdf&subfolder_nav_tracking=1

Provenance (2016b). From shore to plate: Tracking tuna on the blockchain. *Provenance*: Taken from: https://www.provenance.org/tracking-tuna-on-the-blockchain

Provenance (2017). A grassroots approach to proving fair pay with Fairfood. *Provenance*: Taken from: https://www.provenance.org/news/movement/fairfood

Raval, S. (2016). *Decentralized Applications: Harnessing Bitcoin's Blockchain Technology*. Sebastopol, CA: O'Reilly.

Ries, T.E. (ed.). (2019). *2019 Edelman Trust Barometer Global Report*: Taken from: https://www.edelman.com/sites/g/files/aatuss191/files/2019-02/2019_Edelman_Trust_Barometer_Global_Report.pdf

Savelyev, A. (2018). Copyright in the blockchain era: Promises and challenges. *Computer Law & Security Review*, 34, 3, 550-561. https://doi.org/10.1016/j.clsr.2017.11.008

Schatsky, D., & Muraskin, C. (2015). Beyond bitcoin: Blockchain is coming to disrupt your industry, *Deloitte Insights*: Taken from: https://www2.deloitte.com/insights/us/en/focus/signals-for-strategists/trends-blockchain-bitcoin-security-transparency.html

Schnackenberg, A. K., & Tomlinson, E. C. (2016). Organizational Transparency: A New Perspective on Managing Trust in Organization-Stakeholder Relationships. *Journal of Management*, 42(7), 1784-1810. doi.org/10.1177/0149206314525202

Seligman, A. (1997). *The Problem of Trust*. Princeton, NJ: Princeton University Press.

Smith, M. (2018). Luca Pacioli: The Father of Accounting. Retrieved August 26, 2019. *Available at SSRN:* http://dx.doi.org/10.2139/ssrn.2320658

Strathern, M. (2000). The Tyranny of Transparency. *British Educational Research Journal*, 26(3), 309-321. doi.org/10.1080/713651562

Sztompka, P. (1999). *Trust: A Sociological Theory*. Cambridge University Press: Cambridge.

Swan, M. (2015). *Blockchain: Blueprint for a new economy*. Sebastopol, CA: O'Reilly Media, Inc.

Tapscott, D., & Tapscott, A. (2016). *Blockchain Revolution*. New York, NY: Penguin.

Tapscott, D., & Ticoll, D. (2003). *The Naked Corporation: How the Age of Transparency Will Revolutionize Business*. New York, NY: Free Press.

The Economist (2015). The Trust Machine. *The Economist*: Taken from: https://www.economist.com/leaders/2015/10/31/the-trust-machine

Tse, D., Zhang, B., Yang, Y., Cheng, C., & Mu, H. (2017). "Blockchain Application in Food Supply Information Security", *2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM),* 1357-1361. doi: 10.1109/IEEM.2017.8290114.

Westerkamp, M., Victor, F., & Küpper, A. (2018). Blockchain-Based Supply Chain Traceability: Token Recipes Model Manufacturing Processes. *2018 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social*

Computing (CPSCom) and IEEE Smart Data (SmartData), Halifax, NS, Canada. 1595-1602.doi:10.1109/Cybermatics_2018.2018.00267

Note

[1] While the present work is the fruit of continuous collaboration between the authors, it is specified that paragraphs “Blockchain, disintermediation processes and trust”, “Blockchain, transparency and trust”, and “Conclusions” are attributable to Lorenzo Giannini; paragraphs “Some technical and historical elements of the blockchain” and “Fields of application of the blockchain technology” to Massimo Terenzi. Introduction is attributable to both authors.

[2] Open in two senses. “Open” in the sense of public (i.e. all have access to it) and “open” in the sense of *open-source*: the source code of Nakamoto’s blockchain is not protected by copyright and can be freely downloaded and modified by the users.

[3] Cf. also Tapscott and Tapscott 2016

[4] “Benevolence and generosity (caring, helping, protecting, expressing sympathy, sensitivity to the sufferings of others), for example, I expect my friend to defend me against false accusations. This is the strongest, most risky bet because the probability that most people will be disinterested is low, and that they will take on representative duties, and engage in altruistic help is even lower” (*ibid*., p.54)