Blockchain Technology: Trust and/or Control?

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Abstract—

Blockchain technology is increasingly being seen as a general purpose technology with far reaching (institutional) effects. However, the ongoing empirical blockchain discussions on these effects are unstructured, due to high complexities. Both practitioners and researchers therefore struggle to get to the core of blockchain technology consequences. We use a Grounded Theory approach to map the ongoing blockchain discussion, which leads to our empirical core category that explains the core of the blockchain discussions: *the disintermediation of trust in environments with highly institutionalized values*. Blockchain technology is thus often related to trust in our empirical data. However, following the conceptualization of Reliance – Trust and Control by Nooteboom, we show that blockchain technology should be more related to control, instead of trust. Futhermore, we argue that complete control is not always possible in blockchain-systems due to inherent character of decentralized decision making and thus, trust is still a factor in some blockchain environments. We conclude that blockchain technology is a technology that increases control over counterparties in a transaction, but decreases control from a systems-perspective. A transfer of power in the system therefore takes place in blockchain environments. We therefore present our final core category as: power transfer in environments with highly institutionalized values. This strong conceptualization of blockchain technology helps actors understand and discuss the essence of blockchain technology, and provides a much-needed empirical basis for further scientific research.

Further development of this conceptualization of trust and control is needed to structure the ongoing blockchain discussions in both scientific literature and practice.

Keywords – Blockchain Technology, Reliance, Trust, Control, Grounded Theory, New Institutional Economics

I. Introduction

Blockchain Technology, the database technology most well-known for the BitCoin implementation (Nakamoto, 2009), has attracted the interest of actors throughout sectors, organizations and society. Blockchain Technology is currently seen as one of one of the most important trends to watch by Harvard Business Review (Webb, 2015) and one of the 10 strategy trends in technology for 2017 by Gartner (Cearley, Walker, & Burke, 2016). Scientific literature on Blockchain Technology is still scarce however. In a literature review on scientific blockchain literature, Yli-Huumo et al. (2016) conclude that most literature is still focused on BitCoin implementations and the technical challenges of implementing blockchain technology. They call for research on "the possibilities of using Blockchain in other [than BitCoin and Cryptocurrency] environments" (p.21).

Thus, scientific analyses of blockchain technology from an economic, non-technical perspective is scarce. In one of the few papers on this topic, Davidson, De Filippi, and Potts (2016) argue that one can take two perspectives on the economic effects of blockchain technology. First, a Neo-Classical Economics (NCE) perspective, in which blockchain can be seen as "a new general purpose technology puts them in the same class of technological trajectories (Schumpeter, 1939) as for instance electricity, transistors, computers, the internet, mobile phones, and so on (Perez, 2009)" (p.2). However, they argue that blockchain is more than that, and should be seen from a New Institutional Economics perspective, as blockchain technology can not only lower production costs (NCE), such as increasing efficiencies and decreasing risk, but also lower transaction costs (NIE). Davidson et al. (2016) argue that blockchain technology is "better understood as a revolutionary new institutional technology for economic coordination" (p.2) and thus, that blockchain is "an institutional technology of governance that competes with other economic institutions of capitalism, namely firms, markets, networks, and even governments"(p.1). MacDonald, Allen, and Potts (2016) us a similar argument to argue that "blockchains compete with banks as organizations, enabling banking transactions to shift out of centralized hierarchical organizations and back into decentralized markets" (p.1).Although we follow this argumentation, this is often not followed in practice. Most publications by corporates on blockchain technology take a perspective that focuses on efficiency gains, in the sense of

NCE (e.g. Credit Suisse, 2016; McKinsey & Company, 2015). Together with the high number of actors involved in these discussions, such as governments, corporates, new entrants and software developers, and the high technological complexities of blockchain technology, blockchain has become a complex multi-actor system (Pruyt, 2010). This causes high uncertainties, and thus an unstructured discussion on the consequences of blockchain technology has emerged. Both practitioners and researchers struggle to get to the core of the consequences of blockchain technology. Therefore, this paper aims to provide more structure to this discussion, to help actors with the decision whether to implement blockchain technology.

We structure the discussion through the emergence of a conceptualization of blockchain technology, using a Grounded Theory approach. This research answers the following research question: "Which consequences can be discerned and conceptualized of implementing blockchain technology?

In this research, blockchain technology is defined as: *Blockchain technology is a distributed, shared, encrypted, chronological, irreversible and incorruptible database and computing system (public/private) with a consensus mechanism (permissioned/ permissionless), that adds value by enabling direct interactions between users.*

This paper is structured as follows: section II discusses our research approach, the Straussian Grounded Theory Approach. Section III discusses the outcomes of our research, and section IV elaborates on the literature comparison that was performed to further strengthen our mapping of the blockchain discussion, which is aimed at trust research.

II. Research approach

In this paper, we use the Grounded Theory (GT) approach (Glaser & Strauss, 1967). Grounded Theory is a highly explorative research method, which is aimed at developing a theory based on empirical, qualitative and quantitative data. Creswell (2009, p. 14) defines Grounded Theory as "a qualitative strategy of inquiry in which the researcher derives a general, abstract theory of process, action, or interaction grounded in the views of participants in a study". This allows us to use empirical data as an input for a conceptual framework that captures the consequences of implementing blockchain technology. Our data consisted of 56 empirical pieces of literature that emerged in a process of *theoretical sampling* (Glaser & Strauss, 1967), ranging from corporate reports on blockchain technology, technical whitepapers, start-up websites and critical journalism. We only considered non-scientific literature, to stay as close to the empirical discussion as possible. Empirical data was collected using Google, with search terms "Blockchain, Distributed Ledger Technology, Report, Use case, Effects, Issues, Functions". We only selected articles that followed our definition of blockchain technology, selected in-depth overviews over summarizing articles, and omitted highly technical whitepapers that provided no insights into the expected effects of blockchain technology. This data was coded by the researcher (Strauss & Corbin, 1990) using the computer-aided qualitative data analysis software ATLAS.TI (Friese, 2016). We then used a Straussian Grounded Theory approach (Corbin & Strauss, 1990), which consists of an Open, Axial and Selective coding phase, to discern and conceptualize the consequences of blockchain technology. In these phases we used Sensitizing Concepts (Blumer, 1954) to provide structure to the analysis. These were: Actors, Issues, Functions and Effects.

This resulted in an empirical Core Category, a single category that explains the current discussion on consequences of blockchain implementation. This core category is presented in Section III. This empirical core category is then related in section IV to existing research in other fields, to further develop our conceptualization of the consequences blockchain implementation.

III. Grounded Theory RESULTS

This section discusses the results of our Grounded Theory approach, the emergence of our empirical Core Category. We provide a short summary of the thorough, step-by-step argumentation of Meijer (Forthcoming).

We argue, based on the following dimensions found in empirical data, that the main function of blockchain technology, *immutable recording of transacted assets,* enables counterparties without a basis for trust to *transact assets without an intermediary*. Thus, blockchain technology enables the removal of a *trusted intermediary* in transactions. Empirically, the consequence of blockchain technology is therefore captured by the notion: *The Disintermediation of Trust* (Figure 1).

Empirical data showed that blockchain technology is primarily used in the following <u>environments</u>: *Finance, Health, Government, Insurance, Internet of Things, Music, Organizational,* and *Advisory.* These environments are environments that are highly reliant on *values*, such as trust, customs and culture, which are institutionalized through a legal or institutional framework, or history. Due to these values, these *environments* were not disrupted by recent ICT-innovations, such as the Internet and Platforms (as defined by (Hagiu & Wright, 2015)). Thus, blockchain technology is perceived as most useful in *Environments with highly institutionalized values.*

The empirical Core Category that emerged in our Grounded Theory approach is thus: "disintermediation of trust in environments with highly institutionalized values" (Meijer, Forthcoming, p. 51). This Empirical Core Category is related to existing literature in the following sections to strengthen

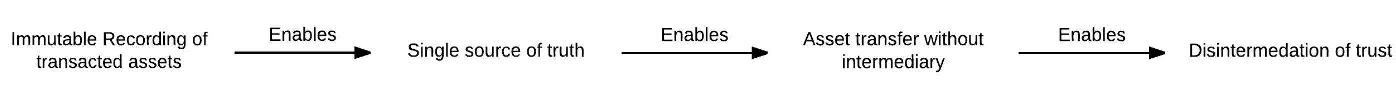

Figure 1 Overview of blockchain enabling a disintermediation of trust (Meijer, Forthcoming, p.46)

and refine it, to form our final Core Category.

IV. Literature comparison of our Core Category

In this section, we relate our Core Category of the blockchain discussion (disintermediation of trust in environments with highly institutionalized values) to existing literature in other fields. We focus on *Trust Research,* because our Empirical Core Category shows that shifting trust arrangements are the most important perceived consequence of blockchain technology.

A. Conceptualization of Trust

A multitude of conceptualizations of trust exist (Seppänen, Blomqvist, & Sundqvist, 2007). In this research we use the conceptualization of Trust by Nooteboom (2002), as it provides a high-level overview of Trust, including both personal and organizational trust, mitigation measures, and is based in Transaction Cost Economics/Institutional Economics.

Nooteboom (1996, 2002)[1] provides a high-level overview of trust, which is visualized in Figure 2. Nooteboom conceptualizes trust in two types: *Competence trust* and *Intentional Trust*. The former being the trust that one (trustor) has in the abilities of a counterparty (trustee). This includes for example technical, organizational, cognitive abilities. The latter involves the trust one has in the intentions of a counterparty, especially how he might deal with opportunism.

This *Intentional Trust* is then divided into two concepts: *Active Intentional trust* and *Passive Intentional trust*. Here, passive intentional entails a dedication to perform to the best of your abilities, and is therefore also called *Trust in Dedication. Active intentional Trust* is concerned with "interest seeking with guile" (Williamson, 1975), the belief that a counterparty will not take advantage by lying, stealing or cheating, and is therefore called *Trust in Goodwill*.

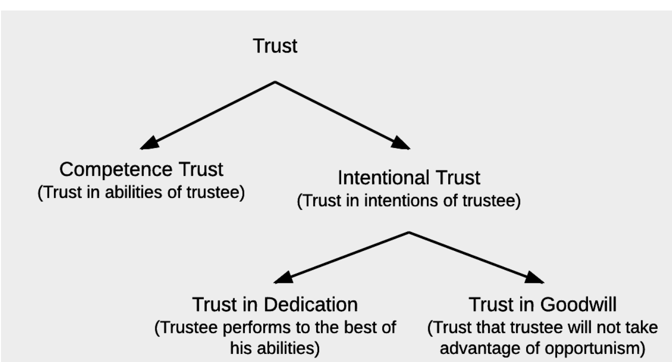

Figure 2 Conceptualization of Trust by Nooteboom (2002)

Nooteboom (1996) also conceptualizes mitigation measures, or measures to *control* a counterparty. Three main categories are conceptualized as (and visualized in Figure 3): *Opportunity control, Incentive control* and *Benevolence.*

Opportunity Control entails controlling the opportunism that the counterparty, or trustee, has. The trustor restricts the possible actions that the trustee can make, thereby limiting opportunism. *Incentive control* entails incentivizing the trustee to refrain from opportunistic behavior due to dependency on the trustor, for example "hostages", relational consequences of material consequences. *Benevolence* limits the inclination towards opportunistic behavior by using norms, values or relations.

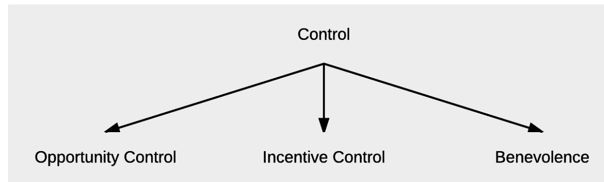

Figure 3 Conceptualization of Control by Nooteboom (2002)

Finally, (Nooteboom, 2002) suggests to use the term *reliance* as an overarching term that includes on the one hand *control* and on the other hand *trust,* reliance beyond control.

We use this conceptualization of trust, as Reliance, Trust and Control, to compare to blockchain technology. Is our empirical data referring to trust as conceptualized by Nooteboom, or to something else?

B. Blockchain Technology, Trust or Control?

This section looks back at our empirical data to further develop our core category, using Nooteboom's conceptualization of Reliance, Trust and Control. First, it uses examples of notions of trust in our Empirical data to analyze these arrangements. Then, it uses practical examples of relations from an end-user perspective in blockchain technology.

1) Analyzing empirical data

Our analysis of the empirical data finds the following: more than 50% of articles use the term *Trust* in the text. This is still comparatively low, if we look at the importance of trust in this blockchain technology. However, when we take technical white papers, highly specialist implementations and critical journalistic pieces out of the equation this number becomes much higher (70%). This is also much higher than either control (10%), or reliance (5%). This was expected, as our current core category refers to trust instead of control or reliance. Trust is thus often used, but do these actors use trust as conceptualized by Nooteboom? We argue, using the support of the following two quotes found in our empirical data, that they mean Control. These quotes represent a larger trend in our empirical data.

Credit Suisse (Credit Suisse, 2016)

"Disintermediates trusted third party solving prisoners dilemma. To transact, you must trust that the:
- Value transfer commitment between parties will be met;
− Other party has ownership over the value they agreed to transfer;
− The value transferred is legitimate."

[1] Klein Woolthuis, Hillebrand, and Nooteboom (2005, pp. 814-817) provide a full overview of the conceptualization of trust by Nooteboom (1996, 2002) and is used as a basis for this section.

IBM(IBM, 2016)

In business, trust is incredibly hard to engineer and impossible to guarantee. Until now, we've relied on instruments and institutions to be surrogates for our trust. With blockchains, trust can be embodied in the transaction itself. A far greater assurance of trust is now possible.

Both quotes claim that blockchain enables "trust", but they provide examples of how blockchains increase the possibility of Control, instead of Trust. This trend is seen throughout our empirical data. This leads us to two important provisional conclusions:

A) Blockchain technology is empirically often related to trust, but should be related to Control
B) Empirical data suggests that if complete control is possible in blockchains, no trust is needed.

The second conclusion relates to research into whether trust and control are substitutes or complements. Klein Woolthuis et al. (2005) conclude that trust and control can be substitutes (as well as complements), but that complete control is not possible. Futhermore, Nooteboom (2013, p. 107) concludes that "Complete, that is, unconditional or blind trust, is ill advised, and where trust ends one needs control. Vice versa, complete control is impossible, and trust is needed where control ends". Thus, current trust research implies that complete control of a counterparty is (so far) impossible. To further explore this difference, we look at examples of relations in blockchain systems, and analyze how both trust and control arrangements are affected by blockchain technology.

2) Blockchain reliance arrangements in practice

We look at three relations in blockchain technology from an end-user perspective: End-User to End-User (simple, cryptocurrency transaction), End-User to End-User (Complex blockchain transaction), End-User to "System".

a) End-User to End-User (simple, cryptocurrency transaction)

This arrangement is between two end-users in a simple transaction, such as a BitCoin transaction. Reliance in this transaction can be completely captured by Control, as both parties are completely bound by rules of the system, thus providing complete *opportunism control.* Examples of these transactions might also include unambiguous transactions like electricity in a blockchain peer-to-peer electricity system.

b) End-User to End-User (Complex blockchain transaction)

This arrangement is between two end-users in a complex transaction, such as notary transactions of assets such as houses or diamonds, or transactions involving real world actions, such as investing in t-shirts or building a real house. It is questionable if complete control is possible in these transactions. Notary transactions, such as buying and selling houses, are highly complex and personalized. Can we rely on our counterparty not to create opportunistic contracts, in which (for example) our house is sold for 1 dollar? Is the quality of the house as presented, or will it collapse soon? Unless the trustor completely understands the contract and the build-quality, complete control is thus impossible in this scenario, even though the possibilities of control are significantly increased. The trustor still needs to have *intentional trust* in the trustee. There probably are mitigating measures one could take, but solely implementing a blockchain will not provide complete control. Therefore, in certain complex blockchain transactions complete control is impossible, as the trustee still needs *intentional trust, or competence trust* (can this builder actually build this house).

c) End-User to "System"

This arrangement is between the end-user and the blockchain system. This includes developers, miners/validators and technology. Blockchain provides strong *incentive control* for behaving as expecting in the system; market mechanisms make sure that (for example) BitCoins decrease in value if the system is compromised. Furthermore, *opportunity control* is high as a single bad intention will not change the way the system works, due to democratic mining. However, is *complete* control possible? We still rely on developers to create *complete contracts*, without errors. The hack of the DAO (Coindesk, 2016) shows that errors, or incomplete contracts exist in blockchain technology. We must still trust the intentions of validators/miners to act as expected, even though there are strong control mechanisms in place. Thus, is it possible to create complete control from an end-user to "system"-perspective? Theoretically, it might be possible, but this argument is strongly based on the existence of *complete contracts*, which (according to) Nooteboom do not exist. In practice, one should at least consider the possibility that complete control is not possible in blockchain technology from systems-perspective.

We conclude that a shift in *Trust-arrangements* perceived in empirical data as the most important consequence of blockchain technology, but that we should be discussing shifting *control-arrangements*. Futhermore, we argued that complete control is not always possible in some blockchain transactions or systems and thus, trust is still a factor in some blockchain environments. We therefore refine our Core Category to: ***disintermediation of control in environments with highly institutionalized values***

Blockchain technology thus increases the control between counterparties in a transaction. However, this is not necessarily the case from a systems-perspective. This is discussed in the following section.

C. Control from a systems-perspective

Blockchain environments are not only technologically highly decentralized, their decision-making structure is also highly decentralized. In this section, we compare our refined Core Category to *Decentralized Decision Making literature* to further develop these insights. We use Bonabeau (2009), an expert on collective intelligence in complex systems, to identify the main issues of *decision-making* in decentralized systems. Bonabeau concludes that "common to all forms of collective intelligence, is a loss of control" (p.48). In blockchain technology environments, control from a systems-perspective thus *decreases.*

D. Final Core Category development

Blockchain Technology is therefore a technology that increases control over counterparties in a transaction, but decreases control from a systems-perspective. End-Users in the system experience an *increase* in their power, while power is *decreased* from a systems-perspective. As both an increase and a decrease in power is achieved, *power* is *transferred.* Therefore, we conclude that our final core category is updated to: **power transfer in environments with highly institutionalized values.**

V. Conclusion

This paper provided an overview of the current blockchain discussion by using a Grounded Theory approach. Our empirical Core Category emerged as: *disintermediation of trust in environments with highly institutionalized values.* Blockchain technology is thus often related to trust in our empirical data. However, following the conceptualization of Reliance – Trust and Control by Nooteboom, we show that blockchain technology should be more related to control, instead of trust. Futhermore, as complete control is not possible in some blockchain transactions or systems, trust is still a factor in blockchain environments.

At first sight, this is just a semantic difference. However, this difference could further structure the blockchain discussions, and provides both practitioners as researchers with an important caveat to blockchain implementation: complete control, making trust unnecessary, in blockchains might not always be possible, even though blockchains do significantly improve the possibilities for control. Actors should therefore consider blockchain technology from a *control-perspective* instead of a *trust-perspective* to fully understand this technology.

Furthermore, we concluded that blockchain Technology is a technology that increases control over counterparties in a transaction, but decreases control from a systems-perspective. A transfer of power in the system therefore takes place in blockchain environments. We therefore present our final core category as: **power transfer in environments with highly institutionalized values.**

This conceptualization of blockchain technology helps to create understanding of the possibilities of the technology and enables actors to discuss the *essence* of blockchain consequences, thereby structuring this discussion and helping actors with the decision whether to implement blockchain technology. Furthermore, it presents a much-needed scientific basis for further research into blockchain technology.

We recommend to use a New Institutional Economic/ Transaction Cost Economic approach to analyze blockchain technology, as argued by Davidson et al. (2016). It enables us to further develop the notions of opportunism control, as according to Williamson (1979, p. 234): "opportunism is a central concept in the study of transaction costs". Furthermore, the possibly far reaching societal consequences of blockchain technology are better understood through changing arrangements throughout society, which also calls for a NIE approach. Finally, concepts like *Cognitive Dissonance (Deutsch, 1973)* could be used in conjunction with NIE to explain the encapsulation efforts by incumbents.

Further development of our conceptualization of trust and control is needed to structure the ongoing blockchain discussions in both scientific literature and practice. More research is needed into the question when, and if, blockchains can provide complete control, thereby creating complete contracts.

Finally, further research into the specifics of the *power transfer* in blockchain technology is needed. The disintermediation of one party is often followed by re-intermediation by another party. To what extent new intermediaries are created, what powers these intermediaries have and how this influences the consequences of blockchain technology should be further researched.

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