A Blockchain-based Inter-organisational Relationships: Social and Innovation Implications

ABSTRACT

Contemporary businesses increasingly adopt algorithmic technologies to facilitate inter-organisational coordination. One example of this trend is a blockchain-based smart contracting, also known as smart contracting, which autonomously executes actions when encoded conditions are satisfied. While an emerging body of literature provides some evidence of positive associations between smart contracting and operational performance reflected in the reduction of transaction costs and improvement of transaction efficiency, research has yet to explore how these novel, technology-based governance mechanisms can affect relational resources, mainly social capital, often required to produce innovation performance. Therefore, by adopting the social capital lens, this study investigated the social and performance implications of smart contracting. Adopting a mixed-methods strategy, data collection included collecting insights from field experts, using the Delphi method, followed by semi-structured interviews with executives of firms that either use this technology or facilitate its implementation. The findings revealed that smart contracting directly affects the formation and structure of inter-organisational social capital, which can subsequently contribute to innovation performance. We also developed an evidence-based model that critically integrates factors influencing the relationship between social capital and innovation performance. Interestingly, system trust, as trust in technology, is found to be the key contextual factor, driving most aspects of inter-organisational collaborations. The study advances our understanding of how inter-organisational relationships can evolve in the smart contracting settings.

KEYWORDS: inter-organisational relationships; social capital; trust; blockchain; smart contract

INTRODUCTION

Blockchain technology is beginning to rewire inter-organisational business processes (Lumineau, Wang, & Schilke, 2020), potentially affecting relational resources (Koghut, Al-Tabbaa, & Meyer, 2019; Murray, Rhymer, & Sirmon, 2020). Despite growing scholarly interest to this technology (e.g. Murray, Kuban, Josefy, & Anderson, 2019; Seidel, Horsch, & Eickstädt, 2020) in the light of its increasing adoption (Deloitte, 2018; Hileman & Rauchs, 2017), surprisingly little research focuses how this technology may transform inter-organisational relationships from the relational view.

Businesses continue to recognise the need for collaborative relationships with their partners, beyond mere coordination, as a means to creating competitive advantage through relational rents[1] (Dyer & Singh, 1998; Koza & Lewin, 1998). In this regard, knowledge transfer between partners is seen as one of the main drivers for relational rents (Dyer & Singh, 1998), and depends on the ability of the partners to have direct, extensive, and intimate face to face interactions (Arrow, 1974; Badaraco, 1991). However, contemporary inter-organisational interactions are becoming more impersonal by way of email, text, and the internet, but more progressively, through the automation of some workflow processes that previously involved human actors (D. Tapscott & Tapscott, 2017). Evidently, the nature of such technology-driven *impersonalisation* of business relations is qualitatively different from the conventional conceptualisations of impersonal systems that yet facilitate business action by means of human actors (e.g. Coleman, 1990; Giddens, 1990; Lane and Bachmann, 2001; Shapiro, 1986). The emergence and increasing implementation of autonomous non-social agents is what typifies the modern business environment and calls for revision of extant relational theories and approaches which might be ill-equipped to capture the true nature of that technology-dependent environment (Baum & Haveman, 2020). In

[1] Following Dyer & Singh (1998), we define relational rents as a "supernormal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners" (p. 662).

particular, such developments challenge Granovetter's (1985) *now* classic idea on the importance of social embeddedness that underpins most relational theoretical perspectives in organisational discourse and practice (Haveman & Wetts, 2019).

One example of the algorithmic technologies impersonalising business relations is a blockchain-based smart contracting, also known as smart contracting, which autonomously executes actions when encoded conditions are satisfied (Murray et al., 2019). Smart contracting automates some inter-organisational business processes that previously involved human decision-makers such as managing finance (A. Tapscott & Tapscott, 2017) or supply chains (Casey & Wong, 2017). Such a reduction of human agency and involvement bears significant implications for organisational theories and managerial activities (Lumineau et al., 2020; Seidel, 2018). Although some theoretical contributions related to the issue emerge (e.g. Lumineau et al., 2020; Murray et al., 2019, 2020; Seidel, 2018), empirical studies on how smart contracting can effect inter-organisational relational resources and ensuing outcomes are lacking (Casino, Dasaklis, & Patsakis, 2019; Macrinici, Cartofeanu, & Gao, 2018). More specifically, while an emerging body of literature provides some evidence of positive associations between smart contracting and operational performance reflected in the reduction of transaction costs and improvement of transaction efficiency (S. E. Chang, Chen, & Lu, 2019; Roeck, Sternberg, & Hofmann, 2019), research has yet to explore how these novel, technology-based governance mechanisms can affect the development of inter-organisational relational resources such as social capital often required to produce innovation performance. Therefore, the purpose of this study is to explore the social and performance implications of smart contracting by addressing the research question: How does smart contracting influence inter-organisational social capital and ensuing performance?

In addressing this question, we adopted the three-dimensional perspective of social capital (Nahapiet & Ghoshal, 1998) to investigate the change and outcomes of inter-organisational relationships in the smart contracting settings. Given the nascent nature of the phenomenon of smart contracting and the lack of related empirical literature, our methodology

comprised two phases. The first phase was necessary to explore the phenomenon and clarifies its conceptual boundaries, where the second one was designed to build the theory. In the first phase, we used the Delphi method (Linstone & Turoff, 2011; Okoli & Pawlowski 2004) to explore the link between smart contracting and inter-organisational social capital. The preliminary conceptual model was derived from insights collected from 28 field experts who had a practical experience with the phenomenon. In the second phase, we advanced the model by using analytic induction (Johnson, 2004; Znaniecki, 1934) applied to data collected through semi-structured interviews conducted with 25 executives of organisations that have either implemented smart contracting for external operations as the users of the technology or facilitated the technology implementation as the service providers.

THEORETICAL BACKGROUND

Blockchain-based Smart Contracting

Blockchain is an Internet-based technology that can be described as a digital distributed ledger consisting of interrelated blocks of highly encrypted information that represents a record of the transactions that occur within a network (Lansiti & Lakhani, 2017). This technology, through its autonomous capabilities, can facilitate substantial improvements in contracting, enforcement, and compliance amongst partners by embedding so-called smart contracts – digital agreements whose terms are recorded in a computer code and which can be automatically executed by the system when certain pre-defined conditions are met (Murray et al., 2019). Consequently, the implementation of such contractual advances denotes conceptually different governance mechanisms, thus changing how conventional inter-organisational processes are organised and managed. In particular, this unique technology will likely disrupt the inter-organisational processes of negotiating and contracting (Eenmaa-Dimitrieva & Schmidt-Kessen, 2019; Murray et al., 2019) as well as affect the dynamics of inter-organisational trust (Dubey, Gunasekaran, Bryde,

Dwivedi, & Papadopoulos, 2020; Koghut et al., 2019; Roeck et al., 2019), which all play an important role for firms' performance (see Vlaar, 2008).

Many recently published literature reviews on the blockchain phenomenon (e.g. Casino et al., 2019; Hawlitschek, Notheisen, & Teubner, 2018; Risius & Spohrer, 2017; Zhao et al., 2019), show that the main focus of the studies is on the economic effects (e.g. cost reduction, disintermediation), privacy and security issues related to the implementations of this technology whereas limited attention has been given to social implications of this technology. Indeed, many studies (e.g. Y. Chang, Iakovou, & Shi, 2019; Liu & Zou, 2019; Mendling et al., 2018; Min, 2019; Roeck et al., 2019) focused on how blockchain technology may affect organisations, few however have actually analysed how this technology can influence social aspects of inter-organisational relationships (Lumineau et al., 2020). Existing research generally suggest that blockchain technology (Y. Chang et al., 2019; Dubey et al., 2020; Treiblmaier, 2018; Wang, Singgih, Wang, & Rit, 2019), and more specifically smart contracts (Koghut et al., 2019; Roeck et al., 2019; Ryan, 2017), influence the development of inter-organisational trust, whereas other aspects of inter-organisational relationships such as social networks, interactions, interdependence, norms, amongst other, remain overlooked. These relational aspects, often conceptualised as inter-organisational social capital (Nahapiet, 2009), are fundamental for understanding how performance can be affected by the change of governance processes brought by technological advances (Vlaar, 2008). The resulting change may bear some important implications for organisations such as knowledge exchange and innovations (Inkpen & Tsang, 2005, 2016; Manning, 2010), and ultimately performance (Graca, Barry, & Doney, 2015; Ireland, Hitt, & Vaidyanath, 2002). Yet, to our best knowledge, no studies have investigated from a more holistic, multi-dimensional perspective how smart contracts can change inter-organisational relationships and resulted performance. Thus, to address this gap, we aim to investigate the relationships between smart contracting, social capital, and performance.

Social Capital

As noted, we adopted the social capital perspective to explain how relational resources and ensuing outcomes can change in the smart contracting settings. Social capital is built by being part of social activities (Putnam, 1993). It can be defined as "investment in social relations by individuals through which they gain access to embedded resources to enhance expected returns of instrumental or expressive actions" (Lin, 1999: 39). Indeed, prior research shows that building social capital between business partners may allow them to gain access to and leverage resources residing in the relationship (Autry & Griffis, 2008; Cousins, Handfield, Lawson, & Petersen, 2006). To frame our inquiry, we use the three-dimensional perspective of social capital (Nahapiet & Ghoshal, 1998). In pertinent literature, social capital is characterised by three interrelated dimensions: structural, relational and cognitive (Nahapiet, 2009; Nahapiet & Ghoshal, 1998). The structural dimension includes the network of social connections between actors and the location of each actor's contacts within the network. The relational dimension emphasises the nature and the quality of relationships actors have that influence their behaviour (e.g. trust, commitment, norms). The cognitive dimension focuses on how shared representations, interpretations and systems of meaning amongst actors can yield stable connections. Although in literature these three dimensions have typically been studied independently (Lawson, Tyler, & Cousins, 2008; Maurer & Ebers, 2006; Nahapiet, 2009), some scholars suggest that social capital dimensions are highly interrelated and this plays an integral part in the social capital development (Krause, Handfield, & Tyler, 2007; Nahapiet & Ghoshal, 1998).

RESEARCH METHODS AND DATA

As noted above, virtually no research has been conducted to investigate how smart contracting can influence relational resources such as inter-organisational social capital that aid the conduct of social affairs and potentially affect performance. Therefore, given the nascent

nature of the phenomenon of smart contracting and the lack of related empirical literature, the methodological approach of this study comprised two phases. The aim of the first phase (Study 1) was to explore the phenomenon and answer the question on how smart contracting can influence inter-organisational social capital, resulting in the preliminary conceptual model. Where the second phase (Study 2) aimed at further advancing the model and subsequently presenting and the process model of smart contracting, social capital and performance.

Study 1

To initially understand the complexities of the novel phenomenon of smart contracting, the Delphi method was adopted as an exploratory tool to collect insights from field experts who had a practical experience with the phenomenon (Linstone & Turoff, 2011; Okoli & Pawlowski 2004). About a hundred of international blockchain experts were invited, out of which 47 experts have explicitly agreed to take part in the research, however, only 28 experts have actually participated in the study. The participants had a broad understanding of the technology, its applications, and its effects. Each expert confirmed their past or current engagement (practical experience) in projects involving or based on smart contracts. An exploratory focus group with three field experts was first conducted as a pilot study, results of which served as an initial and preparatory basis for the subsequent step, in which using a web-based qualitative survey, short explanations on how and why smart contracting can influence inter-organisational social capital were collected from international field experts who had a practical experience with smart contracting.

Drawing on these qualitative data, a preliminary conceptual model in the form of provisional propositions was developed. To discern themes that might constitute the basis for the theoretical description and explanation of the phenomenon under study, a more structured second-order analysis was used to view the data at a higher level of theoretical abstraction. Refining the first-order (in-vivo) codes allowed one of the researchers to identify numerous second-order, non-overlapping dimensions or themes (Gioia, Corley, & Hamilton, 2013). To

these themes, theoretical labels were assigned based on a more general description that subsumed the first-order codes. In order to illustrate the transparency of how new themes inductively emerged from data, Gioia's "data structure" (Gioia et al., 2013) was adopted, see Table 1 below. Furthermore, some experts were asked to verify whether their responses (explanations) have been correctly interpreted, and verify and refine (whenever necessary) the generalisation of their explanations for each proposition. This additional "member check" helped to additionally ensure the consistency of the coding by reviewing the emergent 2nd order themes; thereby further enhancing and ensuring validity with the respondents.

Insert Table 1 about here

The preliminary conceptual model was then validated using a web-based consensus-seeking survey completed by experts from the same sample. As suggested by Schmidt (1997), only those proposed explanations that have achieved consensus (≥70%) amongst participating experts were then used to devise provisional propositions on the expected relationship between smart contracting and inter-organisational social capital. The shortlisted 2nd order themes as the most probable explanations for the proposed effects were assembled into three aggregate dimensions and used to devise final propositions on the expected relationships between smart contracting and the corresponding dimensions of inter-organisational social capital.

Study 2

The purpose of Study 2 was by using new empirical material to further advance our understanding about the implications of smart contracting on inter-organisational relationships and thereby refine the theoretical model developed in Study 1. The primary data source for Study 2 was 25 semi-structured interviews conducted over six months. We interviewed highly knowledgeable, elite informants - executive decision-makers, primarily CEOs, of small to medium size companies (SMEs) that either use smart contracts or facilitate their

implementation. Sampling managerial elite of SMEs was informed by methodological necessity of capturing social capital dynamics by collecting insights only from those individuals who were particularly involved in the processes of developing and maintaining relationships with partnering organisations - executives or owner-managers as "owners" of external social capital (Sorenson & Rogan, 2014). The purposeful sampling method was used as it allows to choose respondents who are information-rich and can share detailed knowledge about matter under investigation (Lincoln & Guba, 1985; Patton, 2002). However, the success of gaining access to managerial elite largely depends a great deal on serendipity and social networks (McDowell, 1998; Yeung, 1995). As such, given the difficulties in gaining access to managerial elites, the limited number of smart contracting use cases and the reluctance of organisations to allow access for data collection for various reasons, this research also used a snowball sampling technique (Patton, 2002). Table 2 lists all elite respondents interviewed for this study.

Insert Table 2 about here

We began the interviews by asking informants background questions about their organisations and what role smart contracting plays for them. Given the nature of elite interviewing, the main interview questions were designed to be focused thereby elicit insights (in the limited time frame) related specifically to the interplay between technology and social processes. In order to gain complete information (Eisenhardt, 1989), we prompted informants to give more details when their descriptions were brief or when novel narratives emerged. To enhance the accuracy of information and the robustness of the resulting theorising (Anand, Gardner, & Morris, 2007), we triangulated data sources. The data sources included interviews, e-mails and instant messaging, phone and video conversations, and archival data such as internal documents (e.g. white papers), websites, social media accounts, and news articles. The potential informant bias was addressed in the following ways. First, we gained insights from different participants of the

smart contracting ecosystem (users and facilitators) to triangulate informants' accounts. Second, to limit recall bias and enhance accuracy, we used semi-structured questioning of highly knowledgeable informants focused on recent and important activities (Golden, 1992). Third, we used, whenever possible, an interview approach, similar to "courtroom questioning", focusing on actual accounts of what informants or their companies did or observed others doing (Huber & Power, 1985; Lipton, 1977). Fourth, we triangulated data from multiple informants and archival sources (Kumar, Stern, & Anderson, 1993). Fifth, we promised anonymity to all our informants and their companies to encourage candour. Finally, the informants were motivated to provide accurate information because they share the lack of existing knowledge on the implications of this technology on inter-organisation relations. The informants' strong interest in the focal phenomenon helps improve the accuracy of their accounts (Miller, Cardinal, & Glick, 1997).

In order to develop an understanding of the interpretations or perceptions of the actors being studied, in this case executives as key participants in inter-organisational affairs, it was necessary for analysis to focus on explanations of the actors' actions generated inductively during data collection (see Giddens, 1979). Amongst the two inductive methodologies, the grounded theory and analytic induction, the latter was selected because it can explicitly accommodate existing theories (Johnson, 2004; Manning, 1982) and also facilitate identification of necessary conditions for the phenomenon to be explained (Gill & Johnson, 2002; Robinson, 1951). In the management and organisation research, analytic induction is generally understood as "the process by which a researcher moves between induction and deduction while practicing the constant comparative method" (Suddaby, 2006: 639). In this sense, analytic induction by incorporating the notion of "abduction" (Peirce, 1903) is often seen as an extension of the grounded theory (Suddaby, 2006).

Using an iterative process of analytic induction (Johnson, 2004; Znaniecki, 1934), the collected data were compared against the resulting from Study 1 model used a benchmark for the

analysis. However, despite the versatility of this approach, its logic has an important constrain, that is, it might be unclear whether new insights deriving from the following cases are relevant to the preceding ones. In other words, it was useful to check whether the final model (propositions) represents the findings generally common to all cases while accounting for exceptions. Following Pratt, Kaplan and Whittington (2020), we adjusted the methodological approach to fit the study's objectives. Accordingly, the process of data analysis in Study 2 involved two stages. The provisional propositions derived from Study 1 were first comparatively analysed against the accounts given by informants (e.g. cases), on the case-by-case basis, and then, for conformity purposes, each proposition was compared against the data (all cases selected as final sample) on the proposition-by-proposition basis, and modified accordingly where applicable. Because of space limitations Table 3 below provides the overall evaluation results of this second stage of the analytic induction process. During the second stage of the data analysis, each proposition was compared against data and either received a *direct* support when the informants provided some explanation for the effect, an *indirect* support when the informants explicitly or implicitly agreed that the effect exist but did not offer any explanation particularly supporting the proposition, or required a *reformulation* to account for disagreement or new insights provided by the informants. However, there were instances when some informants, for various reasons, were unable or avoided to answer some questions. Such instances were deemed as neither supporting nor rejecting particular propositions unless explicitly stated by the informants. During this stage, the reformulated propositions related to a particular issue were aggregated into one final, comprehensive proposition that would, to a large extent, encompass the suggestions made by the informants related to the issue. In sum, the process of analytic induction not only helped to further specify and sharpen the initial propositions, but also yielded new insights and propositions that were not anticipated previously. The outcome is the process model that offers explanations about the effects of smart contracting on inter-organisational relations and their subsequent outcomes.

FINDINGS

As elaborated above, this exploratory research, aiming to explain how smart contracting can affect inter-organisational relationships, was conducted in two studies. The results of Study 1 is first described and then evaluated, justifying the necessity for further theoretical development. Subsequently, the description of Study 2's results as the final stage of the research are then presented. Due to space limitations, we report our findings in a relatively concise fashion (restricted in using direct quotes).

Results of Study 1

Drawing on qualitative data collected from field experts who had a practical experience with smart contracting, a preliminary conceptual framework was developed, proposing conceptual boundaries of the phenomenon. The resulted framework includes the three key themes that can serve as the explanatory basis for the relationship between smart contacting and the three dimensions of inter-organisational social capital (structural, relational and cognitive). The three themes that emerged from data are: visibility, automation, and special requirements (see Table 1).

Insert Figure 1 about here

Visibility

The data show that smart contracting through the increased visibility of business processes influences the structural dimension of inter-organisational social capital in two different ways. On the one hand, as argued by experts, because of the enhanced visibility of business processes, the frequency and the opportunity of face-to-face communications between organisations decrease. This includes both the frequency of communications and the opportunity of face-to-face interactions. On the other hand, experts noted that the increased visibility of business processes positively contributes to the development of strong ties between participating organisations. Furthermore, the increased visibility appears to also influence some aspects of relational dimension of inter-organisational capital. Experts generally suggest that

there will be a positive relationship between smart contracting and (relational) trust between organisations. In addition, the increased visibility positively influences the development of perception of interdependence between participating organisations.

Automation

As explicated by experts, the automation of business processes influences the structural aspects of inter-organisational relationships. It was suggested that the very nature of automation implies the reduction of inter-organisational communications used to facilitate the automated processes and that this effect applies to both the frequency of communications and the opportunity of face-to-face interactions between organisations. Also, it has been proposed that technology-driven collaborations required to set up autonomously executing smart contracts facilitate the development of strong ties between participating organisations. Some experts, for example, explained this in the following way: *"Smart contracting ensures that you have to agree with your partners. If successful, this could result in stronger ties" (Expert 8)*.

Smart contracting through the automation of business processes might also increase relational trust between organisations. Experts argued that this is mainly due to the fact that automation requires less subjectivity in the actual execution of exchange processes, compared to the traditional settings, thereby it reduces the related risks. Yet the perception of interdependence between organisations seems to be also affected by the automation. Experts explained that this effect is due to the autonomous nature of smart contracting, that is, the execution can only be stopped or changed if all-parties consensus is reached. It was suggested that this limits unilateral actions for parties and thus contributes to the development of interdependence amongst parties.

Special Requirements

Field experts highlighted that in order to join a partnership that uses smart contracting for inter-organisational exchanges, an organisation needs to meet certain requirements. These

include trusting the ability of the technology to autonomously execute the agreed rules and conditions, the ability of a party to meet particular data standards necessary for an effective data exchange, and to share a particular mind-set that is peculiar to 'early adopters' of technological advances, advocating and promoting the adoption, and seeing themselves as belonging to a 'special community'. The experts have emphasised the important and foundational role played by trust in the system for the formation of inter-organisational relationships compared to relational trust in the counterparty as traditionally assumed (Granovetter, 1985). The data show that in the smart contracting settings where human agency for certain activities is limited by technology, (impersonal) trust in the technological system plays a transformative role for inter-organisational relations. Such system trust is found to substitute relational trust which has traditionally aided the conduct of social affairs. Therefore, we preliminary define system trust *as trust that organisations put in the proper functioning of autonomous technological systems specifically used to facilitate an economic exchange with other organisations in the conditions when building relational trust is either inefficient, unnecessary, or impossible*.

Moreover, for an organisation to effectively achieve the benefits of a blockchain-based partnership, it needs to meet or special requirements such as to adhere to certain data standards, since on a general level blockchain technology is an information processing technology that requires certain standards for information to be processed. Experts suggested that data standards, as a special requirement for partners, in turn, will facilitate the development of common language and codes amongst participants. Experts also noted that, apart from purely technical requirements, a prospective partner is expected to have or develop a 'special community' mind-set.

Evaluation of Study 1 results

Although the main objective of Study 1 has been achieved, that is, to devise a preliminary conceptual model suggesting how smart contracting influences inter-organisational social capital, due to the following explanatory deficiencies and emerged new insights, the resulting model has

thus been regarded as such that requires further theoretical development on the issue rather than a final product of the research. First, some experts argued that the algorithmic nature of smart contracting requires intensive negotiations between parties, particularly during a setting-up stage (i.e. pre-adoption stage). Therefore, it is important to understand how inter-organisational communications are affected during different stages of technology adoption in the smart contracting settings. Second, the resulting model does not fully specify how relational trust between organisations can be affected in the smart contracting settings: increased or substituted. Thus, from theoretical point of view it is important to clarify the role of relational trust and system trust, and whether and how the former can be affected by the latter. Third, another insight that required clarification is the potential performance implications of smart contracting. Apart from general agreement on the technology-enabled (operational) performance, experts have also highlighted that smart contracting can create unique possibilities for additional value creation and innovation. To explicate the conditions for the shift from efficiency (technology-enabled coordination) to innovation (technology-enabled collaboration), more empirical data were required. Finally, from a critical point of view, apart from the insights collected from field experts, the perceptions of other players such as users of technology and vendors would widen the empirical grounding for the theoretical model, thus helping to address the above explanatory deficiencies. Therefore, to avoid theoretical speculation in the light of a relatively limited explanatory material and taking into account the emerged insights, the Study 1 model required further conceptualisation, refinement and validation using additional empirical data, necessitating the additional study, Study 2, the results of which is discussed next.

Results of Study 2

Following from the results of Study 1, the aim of this subsequent stage was to evaluate and advance the preliminary theoretical model which comprises six provisional propositions. To evaluate the validity of these propositions and refine them, a new set of empirical data was

iteratively compared against them using the process of analytic induction (Johnson, 2004; Znaniecki, 1934). As elaborated above, the logic of analytic induction was complemented by an additional step – the model was checked against data in a proposition-by-proposition manner – because of space limitations, we report only the final revision of the model. Table 3 demonstrates the evaluation results of analytic induction. Although most provisional propositions found support in general, some of them required reformulations whereas few were rejected. The following grouped under the three main themes (visibility, automation, and special requirements) provides analysis for each proposition and how it was reformulated or rejected, where applicable. Finally, the performance implications of smart contracting along with the moderating effects are then analysed.

Insert Table 3 about here

Visibility and social capital

As suggested by field experts, the increased visibility will decrease the necessity of communications between participating organisations. While this proposition was indirectly supported (see Table 3), some executives suggested that the reduction in communications between organisations will be unlikely during the pre-adoption stage of technology implementation, pointing to the temporal nature of the reduction effect by the increased visibility. It was argued that during the initial stage, intensive interactions between parties are required to set up the smart contracting system, echoing views of some field experts collected in Study 1. Therefore, this provisional proposition needs to be specified to reflect the temporal nature of the increased visibility's effect on inter-organisational communications. Hence (see also Table 4), the final proposition is:

Proposition 1a: In the smart contracting settings, the increased visibility of business processes will increase communications between organisations (i.e. structural social capital)

during the pre-adoption stage of technology implementation but during the post-adoption stage the communications will be reduced

The next implication of the increased visibility on inter-organisational relations, as suggested by experts, is the potential to promote strong ties between participating organisations. As demonstrated in Table 3, this proposition received a general support from executives and did not require reformulation (see also Table 4), therefore remained unchanged:

Proposition 1b: In the smart contracting settings, the increased visibility of business processes will promote strong ties between organisations (i.e. structural social capital)

Further suggested by experts implication of the enhanced visibility on inter-organisational relations is its ability to promote relational trust between organisations. Although this proposition was drawn on the consensus amongst field experts, it was almost unanimously rejected by the informants in Study 2 as shown in Table 3. This contrasting finding can be explained by considering that the trust issue on the inter-organisational and institutional levels and system trust as a working solution (see proposition 5) emerged as unexpected insights in Study 1, but were only clarified during the interview process in Study 2. Executives of firms that either use smart contracting or facilitate its implementation emphasised that the central motivation to implement smart contracting in the industry is to address the problem of relational trust, which is often problematic, expensive and sometimes even difficult to develop and/or maintain. The informants summarised their disagreement with that smart contracting would promote relational trust in the following ways: "*There's still no trust between people but they trust the system helping them do the business process*" *(Case 15);* "*The idea that you don't need to trust anyone, we call it trustless system because you trust that the code that is executing the interface between you and your counterparty is executing the contract on which you agreed" (Case 20)*. Drawing on these data, it can be concluded that in the light of the prevailing trust issue (e.g. low-trust environment) the ability to develop

relational trust in the smart contracting settings is limited. Instead, in such settings, trusting the proper functioning of autonomous technological systems used to facilitate an economic exchange with other organisations is perceived as more effective and efficient. Hence, this provisional proposition was rejected and substituted accordingly by proposition 5, which is discussed below.

The final implication of the increased visibility on inter-organisational relations is its ability to promote the perception of interdependence between organisations. Field experts asserted that the transparent nature of blockchain technology underlying smart contracting can drive interdependence between participating organisations. Although the informants were somewhat reluctant to explicitly support this proposition, they did not reject it, see Table 3, thus this provisional proposition remained unchanged (see also Table 4):

Proposition 2b: In the smart contracting settings, the increased visibility of business processes will promote the perception of interdependence between organisations (i.e. relational social capital)

Automation and social capital

As explained by field experts, the natural implication of automation will be the reduction of inter-organisational communications. As shown in Table 3, this proposition was generally supported by the informants. The main argument behind the reduction effect is that some information exchanges between firms have been outsourced to the technology. In other words, it is not individuals who use technology to communicate to other individuals, rather it is about machine-to-machine communications. However, several informants pointed to the temporal nature of the reduction effect, arguing that during the implementation stage (e.g. pre-adoption stage) companies actually observe an increase in their communications with partners. Taken together, this provisional proposition required reformulation in order to account for the above insights

shared by informants, reflecting the temporal effect on inter-organisational communications (see also Table 4), thus:

Proposition 3a: In the smart contracting settings, the automation of business processes will increase communications between organisations (i.e. structural social capital) during the pre-adoption stage of technology implementation but during the post-adoption stage the (operational) communications will be reduced

The next implication of the automation on inter-organisational relations, as suggested by experts, is the potential to promote strong ties between participating organisations. This proposition received both direct and indirect support from executives and did not require reformulation, see Table 3, therefore this proposition remained unchanged (see also Table 4):

Proposition 3b: In the smart contracting settings, the automation of business processes will promote strong ties between organisations (i.e. structural social capital)

Further implication of the automation of business processes on inter-organisational relations is its ability to promote relational trust between organisations. In similar vein to provisional proposition above regarding the similar effect of visibility, this proposition is also rejected and substituted accordingly by proposition 5, which is discussed below.

The final proposed implication of the automation is the potential to promote the perception of interdependence between participating organisations. Unlike the proposition 2b which promotes the positive effect of the enhanced visibility of business processes on the perception of interdependence between organisations, this proposition received a relatively more explicit and almost unanimous support from the informants, as shown in Table 3, hence the proposition remained unchanged (see also Table 4):

Proposition 4b: In the smart contracting settings, the automation of business processes will promote the perception of interdependence between organisations (i.e. relational social capital)

Special requirements and social capital

As in joining any network or partnership, a prospective candidate, in this case an organisation, is deemed to satisfy particular requirements. As highlighted by field experts, in order to join a partnership that uses smart contracting for inter-organisational exchanges, an organisation is expected to meet three requirements: (1) trusting the ability of the technology to autonomously execute the agreed rules and conditions; (2) meeting particular data standards necessary for an effective data exchange; and (3) sharing a particular mind-set that is peculiar to 'early adopters' of technological advances, advocating and promoting the adoption, and seeing themselves as belonging to a 'special community'.

The identified first requirement for organisations to form or join a blockchain-based partnership or network is trusting the proper functioning of autonomous technological systems specifically used to facilitate an economic exchange with other organisations in the conditions when building relational trust is either inefficient, unnecessary, or impossible. The general consensus amongst the experts was that, with smart contracting, organisations' trust in autonomous execution of contractual terms will reduce the need to trust their counterparts. As indicated in Table 4.1, this proposition received an overarching support from the informants. Such support can be illustrated by an interesting quote from one executive, who stated that with this technology: *"You're able to trust each other without trusting each other" (Case 10)*. This contradictory, at the first glance, statement reflects a new trusting behaviour emerging within the industry, that is, when the object or reference of inter-organisational trust changes from social to non-social entities, from people or organisations to technology. As reiterated by executives, trusting technology instead of people or organisations is continuously adopted as a new way to govern inter-organisational exchanges in the low-trust contexts. Informants have emphasised that it is more effective and efficient to trust the pre-defined actions of autonomous technologies rather than people who are prone to mistakes. For example, one executive explicitly stated: *"I trust technology more than*

people. I suppose the fact that it's written into an indisputable database, it cannot be questioned in that respect. I think the safety and the trust that it brings … I think predominantly, it is to do with the fact that [the technology] provides that extra layer of security that minimizes the human error element" (Case 1). However, while all informants endorsed the existence of technology-based trust, which this research conceptualises as system trust, and its substitution effect on relational trust between organisations, many explicitly acknowledged that trust in smart contracting, to an extent, also substitutes trust in institutions. Furthermore, it is a shared belief amongst informants that trusting the technology is the precondition for a party to join the partnership or network. In the general sense, smart contracting can be conceptualised as alternative and efficient means to manage inter-organisational processes. Therefore, as grounded in data, the common trust issue is identified as a precondition to form inter-organisational relations. Taking together, system trust can be seen as an underlying normative foundation for inter-organisational relations.

In addition, data give support to a complemental role that system trust can play in creating a trusting and conducive environment for parties to innovate in the smart contracting settings. Some executives acknowledged that, in the light of the prevailing trust issue, smart contracting, due to its unique capabilities to increase the veracity (i.e. trustworthiness) of information exchanged between parties, is perceived as the effective means to drive business relationships beyond the initial contract into innovation activities. This shows that system trust acts not only as an underlying normative foundation for the relationships to emerge, but also as a conducive contextual factor that can make parties to be more confident and motivated to further implement the technology for mutual benefits, thereby moderating the facilitating effects of other factors to innovation activities. Taken together (see also Table 4), this proposition can be reformulated in the following way:

Proposition 5: System trust (as trust in the technological system) will act as a precondition to the formation of inter-organisational relations (a) during the pre-adoption stage, and during the

post-adoption stage it will substitute relational trust between organisations and institution-based trust (b) and moderate the relationship between inter-organisational social capital and innovation performance (c)

Therefore, the earlier preliminary definition of system trust needs to be updated accordingly. Thus system trust can be defined *as trust that organisations put in the proper functioning of autonomous technological systems specifically used to facilitate an economic exchange with other organisations in the conditions when building relational trust and rely on institution-based trust is either inefficient, unnecessary, or impossible*.

The second requirement for an organisation to benefit from a partnership that uses smart contracting for exchanges is certain standards for data exchanged in order to be processed by the blockchain-based technological system. This proposition was explicitly supported by executives and did not require reformulation, as shown in Table 3 (see also Table 4), hence:

Proposition 6a: In the smart contracting settings, the requirement for common data standards will positively contribute to the development of common language and shared codes between organisations (i.e., cognitive social capital)

Finally, the third requirement for an organisation to benefit from a blockchain-based partnership or network is an expectation to share a particular mind-set of 'early adopters', typically advocating and promoting the adoption of new technologies, and seeing themselves as belonging to a 'special community'. It was provisionally suggested that such mind-set will be conducive to the development of common language and shared codes between firms. As indicated in Table 3, while this proposition received some indirect support, in general, it required reformulation. This is because most informants did not report any effect of the 'special community' mind-set on the formation of common language, but rather on the development of shared codes between organisations (see also Table 4), thus this provisional proposition needs to be reformulated accordingly:

Proposition 6b: In the smart contracting settings, the requirement for the 'special community' mind-set will positively contribute to the development of shared codes between organisations (i.e., cognitive social capital)

Performance implications of smart contracting

Drawing on data collected from field experts, it was anticipated that the technology implementation may yield different outcomes for participating organisations. In Study 2, it had become particularly apparent that it was important to differentiate between the smart contracting's outcomes given different interaction dynamics amongst parties during the post-adoption stage as reported by the informants. As a result, two distinct but interrelated performance implications were identified. First, enhanced efficiency as the outcome of the first phase of the post-adoption stage (coordination), and second, innovation as the outcome of the second phase of the post-adoption stage (collaboration), presented below as propositions 7 and 8 respectively.

The pre-adoption stage of smart contracting is characterised by intensive interactions between parties which is necessary to build consensus on how conventional ways of exchange are translated into automated workflows. Hence such intensive interactions can result into the progressive development of inter-organisational social capital during the pre-adoption stage. However, as suggested previously, during the post-adoption stage the interaction between parties tend to decrease due to the enhanced visibility of business processes (see proposition 1a) and the automation of business processes (see proposition 3a). Relatedly, several executives pointed that in the post-adoption stage, in some cases, there can be an increase in the interactions between parties which can partly be contingent upon achieving certain operational performance goals. These observations point to two important implications. First, following the automated coordination facilitated by smart contracting, resulting in the enhanced efficiency, there can be an ensuing, second phase of the post-adoption stage during which organisations can collaborate on innovation. As data show, this can include either business model or product or process

innovation. Second, the enhanced efficiency of inter-organisational exchanges can be seen as one of the drivers for innovation (Vlaar, 2008). As pointed above, smart contracting facilitates a more effective and efficient utilisation of resources by, for example, redirecting some of them to other areas such as innovation or business development. Furthermore, it appears that following the positive results in achieving the efficiency goals parties can become confident and motivated to further implement the technology for mutual benefits.

Departing from these implications, the post-adoption stage can be split into two subsequent and interrelated phases. The first phase can be characterised by automated coordination and limited interactions between parties, the outcome of which is the enhanced efficiency (see proposition 7). During the second phase, the interactions between parties increase, facilitating collaboration which may result in innovation (see proposition 8). As demonstrated in Table 3, proposition 7 received an overarching support from the informants. Data show that the re-invention of business processes is driven by the implementation of smart contracting by some organisations as an efficient alternative to traditional means of inter-organisational governance. The resulting enhanced efficiency, in turn, provides confidence and motivations for parties to further implement the technology for business innovations. This may imply a moderating effect of the enhanced efficiency on the relationship between inter-organisational capital and innovation performance. Furthermore, the positive implications for the enhanced efficiency, both for operation and transaction costs, seem to fortify the initial expectations that parties had for this technology and thereby enhance their put trust in in the proper functioning of autonomous technological systems specifically used to facilitate an economic exchange with other organisations in the conditions when building relational trust is either inefficient, unnecessary, or impossible – hence corroborating system trust. In other words, by enhancing operational performance, smart contracting reinforces parties' system trust, suggesting that there is a (positive) feedback effect form operational performance to system trust. Taken together (see also Table 4), it can thus be proposed:

Proposition 7: Smart contracting will enhance operational performance by reducing operation costs (e.g., communication and labour costs) and/or transaction costs (e.g., governance costs) (a), whereas the enhanced operational performance will moderate the relationship between inter-organisational social capital and innovation performance (b) and will further strengthen system trust during the post-adoption stage (c)

Further, data reveal that inter-organisational social capital is an important driver for the innovation performance. Some executives report that certain inter-organisational implications resulting from the adoption of smart contracting can facilitate collaborative interactions between organisations, which in some cases yield business process or product innovations (i.e. innovation performance). These implications seem to be driven by structural, relational, and cognitive aspects of inter-organisational social capital. With regard to the structural aspects, executives pointed to both stronger ties and change in the nature of communications between parties. Driven by the automation and increased visibility features of smart contracting (see propositions 1b and 3b), strong ties seem to promote innovation activities between parties by connecting them in a more dense, but also transparent, fashion and removing some barriers related, for instance, to data exchange issues such as data verification. Additionally, the change in the nature of communications between parties, or as some executives call it - the quality of conversations, that is, beyond routine, control and reconciliation related communications, as well as in their frequency, seems also to contribute to the increase in innovation performance, for example: *"Smart contracts can create a higher frequency of quality conversation, while reducing the frequency of low-level or low-quality routine conversation" (Case 18)*. Interdependency, as illustrated by the following quote, which reflects relational aspects of inter-organisational relationships, appears to be another facilitating factor for innovations: *"It is a stepping stone for doing that. Because if you are embracing technology where you're all dependent of, then there is a stepping stone to communicate about innovation together" (Case 10).*

Common language, representing the cognitive dimension of social capital, is perceived by some informants as yet another facilitating factor for innovations. For example, one executive exemplified this in the following way: *"... when smart contracts are being built on are very common syntax and common language, it can lead to more complex transactions to do then ... you can then create more volume and more contract transactions" (Case 22)*. Taking the above (see also Table 4), it can thus be proposed:

Proposition 8: In the smart contracting settings, inter-organisational social capital will facilitate innovation performance during the post-adoption stage

Relatedly, data also shows that not all partnerships are able or willing to co-create value. Some executives, for example, highlighted that the improving efficiency is the main and final intent for some organisations to adopt the technology. During the interview process, many informants implicitly mentioned that the shift from the enhanced efficiency to innovation appears to be somewhat dependent upon top-managerial discretion, that is, whether the emerged innovation opportunity can be effectively and efficiently utilised in the current circumstances and aligned with strategic goals. This implies that although inter-organisational social capital together with system trust and the enhanced operational performance can create a conducive environment for innovations opportunities, parties may be less interested in pursuing these opportunities if they do not fit with parties' existing strategies or fall out of the scope of business. This lends to suggest that existing strategic goals can either enhance or inhibit parties' willingness to explore and exploit innovation opportunities in the smart contracting settings (see also Table 4), hence:

Proposition 9: Existing strategic goals/Managerial discretion will moderate the relationship between inter-organisational social capital and innovation performance

Towards a process model of inter-organisational relations in the smart contracting settings

Figure 2 below summarises the findings of this research regarding the effects of smart contracting on inter-organisational relationships, ensuing performance implications, and related contingencies. The (numbered) arrows, in the figure, reflect the corresponding propositions for the direct and moderating effects elaborated above.

Insert Figure 2 about here

The process model, as depicted in Figure 2, illustrates the evolutionary process of inter-organisational relationships, which starts at the pre-adoption stage where parties collaborate on establishing smart contracting and thus develop inter-organisational social capital as a by-product of this collaboration, and subsequently progresses to the post-adoption stage which is characterised by the actual application of smart contracting and, as data show, can be divided into two phases differentiated by outcomes. A typical result of the first phase is operational performance reflected by the reduction of operation and transaction costs while a potential outcome of the second is innovation performance which may include, for instance, business model innovation or product/process innovation.

The collected data suggest a direct, positive relationship between smart contracting and inter-organisational social capital developed at the pre-adoption stage. Through the enhanced visibility and automation of business processes along with special requirements for parties, smart contracting facilitates the development of all three dimensions of social capital: structural, relational, and cognitive. It was however found that both the formation dynamics and structure of social capital in the settings where contracts are executed autonomously by technology are different form the traditional contractual arrangements. These differences are largely driven by system trust as an underlying normative foundation specific to the technology-based arrangements. System trust is found to be a pre-condition to the formation of such arrangements, facilitating the rapidity of social capital formation during the pre-adoption stage of smart contracting implementation. The pre-adoption stage process includes the initial

interactions between prospective partners towards setting up an autonomous contract as an efficient alternative to traditional means of inter-organisational governance. In seeking to reduce operation and transaction costs, those organisations that perceive both relational trust and existing institutions as inefficient mechanisms in facilitating economic transactions retreat to instead rely on technology-based mechanisms such as blockchain-based smart contracting. In this sense, preliminary trusting the proper functioning of autonomous technological systems, hence system trust, becomes a necessary pre-condition to the formation of inter-organisational relationships. In addition to this condition, common data standards and 'special community' mind-set are seen as special, though relatively less important, requirements for prospective partners to join the relationship. When at least system trust is present at the pre-adoption stage, organisations engage in the process of establishing smart contracting through intensive negotiations and collaborations. Data show that, due to the algorithmic nature of smart contracting, interactions amongst parties during this stage are more active and intensive compared to the setting up of a traditional contracting. Accordingly, the formation of inter-organisational social capital during this stage, and particularly its structural dimension, is assumed to be more dynamic than in the traditional settings. Smart contracting drives the development of intensive communication patterns and the formation of strong ties between organisations. In a similar fashion, the relational dimension of social capital, reflected by the perception of interdependence which is driven by the unique features of smart contracting, such as the inability of parties to unilaterally influence the contract execution, also appears to develop relatively quickly. That is in contrast to a relatively less strong perception of interdependence for parties in the traditional contracting settings, in which parties, regardless of exogenous punishment, are able to negate, in full or in part, their contractual obligations.

The formation of the cognitive dimension of social capital at this stage is driven by shared standards and certain mind-set amongst collaborating parties. To benefit from the visibility and automation features of the technological system that helps to ensure a cooperative outcome, parties

strive to establish common data standards essential for the system to operate. This collaboration leads to the development of cognitive aspects of inter-organisational social capital, e.g., shared language, which enhances parties' abilities to effectively communicate with each other. Moreover, parties are expected to either have or develop a so-called 'special community' mind-set, implying a positive disposition towards new technologies as alternative means of governance, and thus emphasising a non-conventional, technology-based approach to govern economic transactions. These shared perceptions lead to the development of common cognitive frames of reference, in social capital's terms, shared codes. The data further suggest, and as shown in Figure 2, the inter-organisational social capital developed in the pre-adoption stage can be directly and positively related to the organisations' abilities to produce innovation performance during the post-adoption stage.

The post-adoption stage, as noted above, can comprise two subsequent phases. In the first, as found in all cases, smart contracting improves operational efficiency by reducing operation and transaction costs. Such an achievement of satisfactory operational performance for some organisations is seen as the main and final intent. Yet, under certain conditions, inter-organisational relationships can progress up to the second phase of the post-adoption stage, resulting in innovation performance. Reaching this phase is however more contingent. It was found that the positive relationship between social capital and innovation performance is moderated by the achievement of operational performance, system trust, and managerial discretion. In this regard, smart contracting, by reducing some operation and transaction costs, enhances operational performance which, in turn, moderates the relationship between social capital and innovation performance and exerts a positive feedback effect on system trust. In this stage, the achievement of operational performance induces parties to interact to further implement the technology for (additional) mutual benefits, thereby enhancing the development of structural social capital between parties. In this sense, as data show, the increased operational performance acts as

a gateway to innovation activities, endogenously supporting the positive association between social capital and innovation performance.

The achievement of operational performance is also found to strengthen system trust that endogenously affects the relationship between social capital and innovation performance. As mentioned, system trust is perceived by parties as an underlying foundation on which the inter-organisational relationships are built and dependent. In the post-adoption stage, system trust is found to be a key contextual factor that substitutes both relational and institution-based trust traditionally used in the inter-organisational governance apparatus, thereby altering the structure of inter-organisational social capital, particularly its relational dimension (e.g., substituting relational trust). This implies the contextual influence of system trust on most, if not all, of the inter-organisational processes executed in the smart contracting settings. Finally, data suggest that the managerial discretion also plays an important role in the achievement of innovation performance. When the emerged innovations opportunities do not fit with parties' existing strategies or fall out of the scope of business, the prediction for this performance is less straightforward and seems to depend on the discretion of decision-makers.

DISCUSSION

With this study, we offer several core implications for the social capital theory, trust research and the studies on inter-organisational relationships. First, this study is amongst the first that have empirically investigated the effects of blockchain-based smart contracts on inter-organisational relationships and related performance from the relational perspectives. We show that both the structure and formation dynamics of structural, relational, and cognitive aspects of inter-organisational relationships in the smart contracting settings appear different to the aspects developed in the conventional settings. In the settings where inter-organisational exchanges managed through autonomous technologies, interactions and communications between organisations related to routine or operational tasks becomes redundant and their focus

shifts towards more strategic conversations often aimed at further utilisation of the technology and innovations. This type of conversations is endogenously supported by other aspects of social capital developed in these settings, such as strong ties, strong perception of interdependence, and shared cognitive frames, as well as by system trust and technology-induced efficiency gains. Unlike in the traditional settings where certain time is required to build social capital (Granovetter, 1992; Gulati & Sytch, 2008; Nahapiet & Ghoshal, 1998), time factor, as the data show, is not amongst the main conditions to the social capital formation in the blockchain context. In contrast, the speed of the social capital development appears to be much higher for the partnerships using smart contracting. In this way, we offer a significant contribution to the emerging literature on the blockchain phenomenon (e.g. Cong & He, 2019; Lumineau et al., 2020; Murray et al., 2019; Seidel et al., 2020), as well as to the scant research on how social capital might evolve or change in different settings (Kwon & Adler, 2014; Payne, Moore, Griffis, & Autry, 2011).

Second, this study is amongst the first that have conceptualised and provided empirical support for the notion of a truly impersonal system trust, pursuing future research directions and thus extending prior studies on system trust (e.g. Bachmann & Inkpen, 2011; Sumpf, 2019). That is, this study shows that non-social entities such as smart contracting can be a means of reassurance for mobilising truly impersonal trust at the inter-organisation level. Departing from sociological conceptualisations of impersonal or system trust, this study puts forward and provides empirical evidence for an alternative conceptualisation of system trust as trust in technological systems rather than in socio-technical systems that traditionally include human agents (who are potentially fallible) that share a role in ensuring overall system trust. The radical denials of 'genuine' trust in non-social entities like technology, as put forward by the most (system) trust scholars (e.g. Coleman, 1990; Giddens, 1990; Luhmann, 1979; Shapiro, 1987) including more recent contributions (e.g. Kohring and Matthes, 2007; Sumpf, 2019), are

now less convincing and perhaps have been one of the main reasons for the limited success of and consequently meagre scholarly interest in system trust theory. This is because the main underlying assumption that trust in technologies is always trust in the social actors who represent these technologies is not always valid in contemporary practice. This is apparent through the emergence and increasing adoption of autonomous technologies such as smart contracting, as this work shows, and artificial intelligence which operations once triggered cannot be manipulated by its users in some settings. To this end, we thus need to attend to the societal and organisational effects of such autonomous non-social entities if we aim to produce contemporary adequate theory that is to inform the effective organisational management in these technology-dependent settings (Lumineau et al., 2020; Murray et al., 2020). Furthermore, this finding echoes prior research (Bachmann & Inkpen, 2011; Lane & Bachmann, 1996) and challenges the assumption about the importance of relational trust for inter-organisational relationships. Such implication is not supportive of Granovetter's (1985) now classic ideas on the importance of embeddedness, that is, in this setting, the presence of relational trust is not the necessary condition for an effective development of social relationships. This finding demonstrates that firms can possibly build external social capital with positive outcomes without relying much on relational trust as traditionally assumed. In this way, the findings challenge the conventional notion about the importance of social embeddedness for effective inter-organisational relations in the contemporary, technology-dependent environment. Relatedly, future studies should scrutinise to what extent and in what ways relational trust influences firms' performance.

Third, given the interest to smart contracting from organisations and governments keeps growing at an increasing pace (Freuden, 2018; Hileman & Rauchs, 2017) and the increasing number of its practical implementations (Deloitte, 2018), this empirical contribution is thus both timely and important for advancing and updating contemporary knowledge since it sheds light on

an alternative mode of governance that already exists in the present business environment and which is beginning to automate, and thus impersonalises, some inter-organisational processes (Lumineau et al., 2020). In this way, this novel, technology-based governance mode bears some important implications for the now two decades-old debates on the relationships between formal and relational governance mechanisms (Arranz & de Arroyabe, 2012; Caniëls & Gelderman, 2010; Dimitratos et al., 2010; Howard et al., 2019; Kwon et al., 2009; Thorgren et al., 2010) and their subsequent influence on inter-organisational relations and performance (Bozec et al., 2010; Filatotchev & Nakajima, 2010; Hagedoorn et al., 2006). Smart contracting is another yet an improved kind of formal governance. It however differs ontologically from conventional contracting and, as this study demonstrates, thus renders largely substitutional effects on relational governance mechanisms, whereas it contributes positively to performance. As such, it adds a new direction to the debates, that is, a novel perspective on governance management in the contemporary, technology-dependent environment (Lumineau et al., 2020; Murray et al., 2020).

Figure 1. Conceptual Model Resulted From Study 1

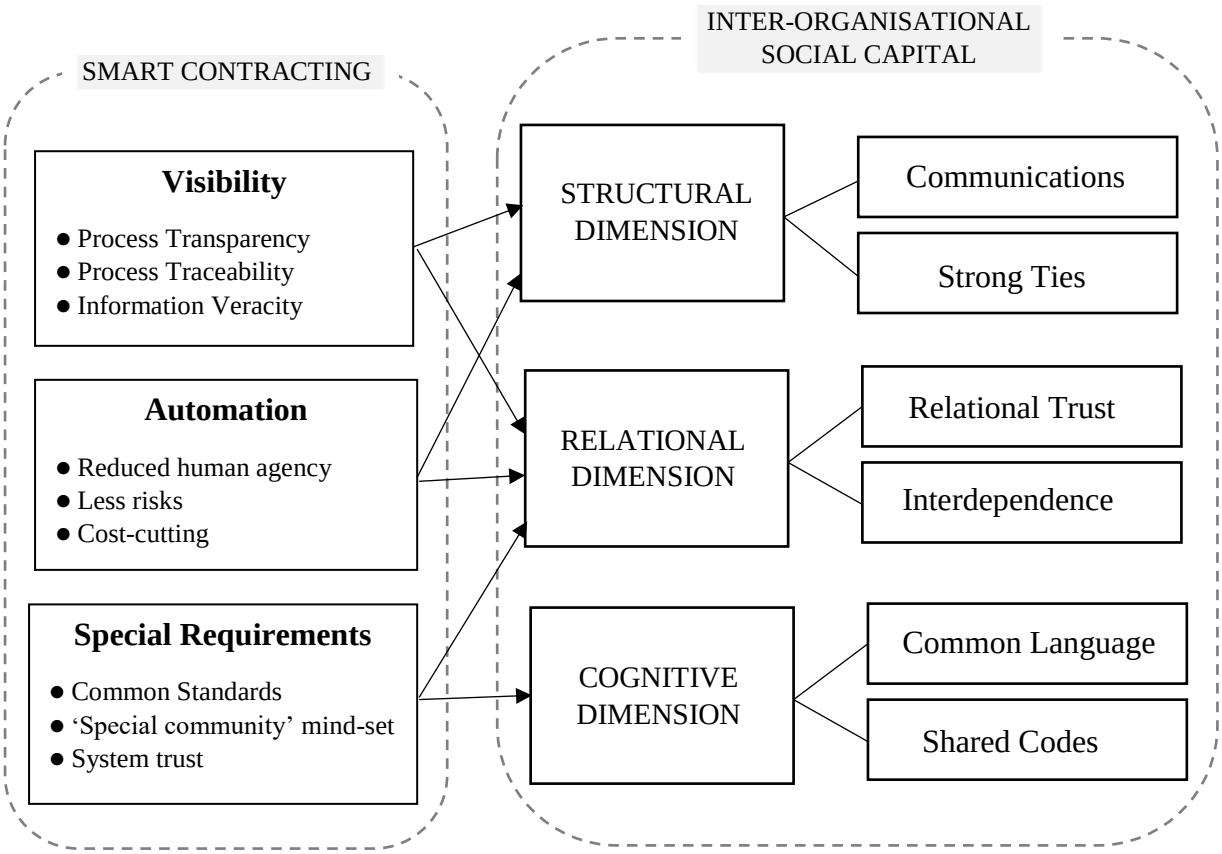

Figure 2. The Process Model of Blockchain-based Inter-organisational Relationships

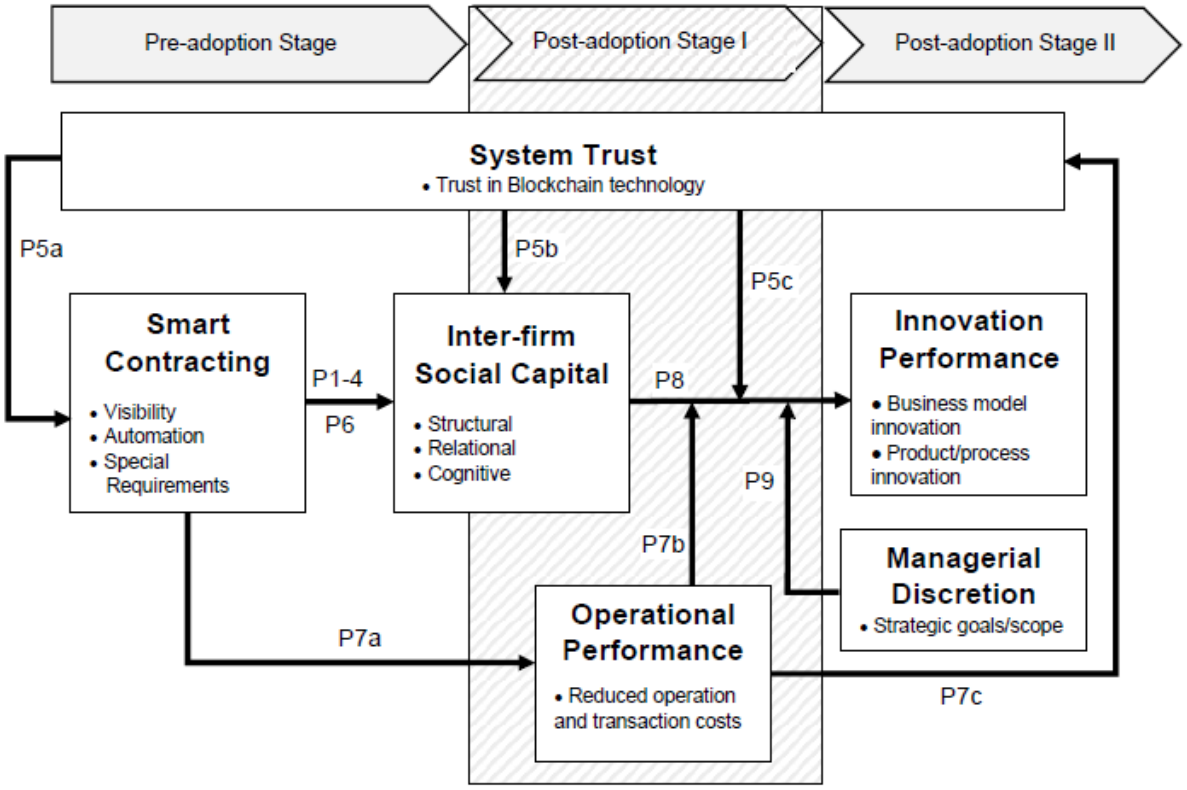

Table 1. Data Structure: Examples of Data Coding (Study 1)

First order (in-vivo statements)	Second order themes	Aggregated themes
"Most smart contracts are built on transparent networks. It is the transaction transparency and the immutability of record keeping" (Expert 7) "With smart contracts you know who had what, when, how long, and what they did" (Expert 10)	Transparency, Traceability, Visibility	**Visibility**
"The blockchain acts as a shared database to provide a secure, single source of truth" (Expert 12) "[Smart contracting helps] sharing one single source of truth between multiple participants" (Expert 24)	Veracity of Information	
"Smart contracts act according to their program" (Expert 9) "Deploying smart contracts will automate exchange of goods/services & execution of agreements" (Expert 10) "Smart contracts automate approvals, calculations and other transacting activities that are prone to lag and error" (Expert 12)	Enabled Secured Autonomous Contract Execution	**Automation**
"Smart contracts limit and decrease human errors, fraud and unscheduled activity … One of the parties can't change anything without the consensus of all the parties" (Expert 1) "By removing some human aspects of execution, there are fewer opportunities for bad behaviour" (Expert 15)	Unilateral Conduct Restricted by Code	
"The current pioneering stage of adopting blockchain technology requires a certain shared mindset that helps to perceive the relation between the involved parties as special" (Expert 15) "There is a blockchain and smart contract community. Organisations that are in this space working on adopting and integrating technological solutions for their own purposes but also because they want to contribute to the development and acceptance of the technology. This drives a "special" belonging between organisations" (Expert 18)	Special Requirements for Entering into the Partnership	**Special Requirements**

"Smart contracts and backbone tech like blockchain provide us with an opportunity to establish common widespread industry standards not only in shared vocabulary and language, but more importantly on data standards" (Expert 6) "Executing transactions with smart contracts require exact and shared definition of the transaction attributes between the engaged parties" (Expert 14)	Fixed Data Input Standards (Shared standards)	

Table 2. Elite Interview Respondents (Study 2)

Case no.	Case Type	Position	Industry	Country	Size of Enterprise*
1	User (pilot)	CEO/Founder	Asset Management	UK	Small
2	Facilitator	CEO	Computer Software	USA	Small
3	Facilitator	CEO	IT Services	India	Small
4	Facilitator	CEO/Founder	IT Services	Netherlands	Medium
5	User	Founder	E-verification	Macedonia	Small
6	User	Partner	Insurance	Taiwan	Medium
7	User	CTO	Supply Chain	Netherlands	Medium
8	User	CEO/Founder	E-verification	Netherlands	Small
9	User	Partner	Digital Contracting	Switzerland	Medium
10	Facilitator	CEO/Founder	IT Services	Netherlands	Medium
11	Facilitator	CEO/Founder	Computer Software	Netherlands	Medium
12	Facilitator	General Manager	IT Services	China	Medium
13	User (pilot)	CEO/Founder	Supply Chain	USA	Medium
14	Facilitator	CEO/Founder	Computer Software	Switzerland	Small
15	User	CIO	Supply Chain	Israel	Medium
16	User	COO	Supply Chain	Slovenia	Medium
17	User	CEO/Founder	Supply Chain	UK	Small
18	Facilitator	VP	IT Services	USA	Medium
19	Facilitator	CEO/Founder	Computer Software	UK	Medium
20	Facilitator	CEO/Founder	Computer Software	Switzerland	Small
21	User	CEO/Founder	E-Commerce	UAE	Small
22	Facilitator	CEO/Founder	IT Services	USA	Small
23	Facilitator	CEO/Founder	IT Services	Republic of Ireland	Medium
24	Facilitator	CFO/Founder	Consulting	Hong Kong	Medium
25	Facilitator	CEO/Founder	IT Services	UK	Small

Notes: * as per the EU Recommendation 2003/361 (medium-sized business has fewer than 250 employees; small-sized business has fewer than 50 employees)

Table 3. Evaluation Results of Analytic Induction (proposition-by-proposition basis)

Cases	Provisional Propositions												
	1		2		3		4		5	6		7*	8*
	a	b	a	b	a	b	a	b		a	b		
1	IS	NA	RF	NA	DS	NA	RF	DS	RF	DS	NA	DS	NA
2	IS	IS	NA	NA	IS	IS	NA	NA	DS	NA	NA	IS	IS
3	IS	IS	RF	NA	DS	IS	RF	DS	RF	DS	IS	DS	RF
4	RF	IS	RF	NA	RF	IS	RF	DS	RF	DS	IS	DS	IS
5	NA	NA	RF	NA	NA	DS	RF	DS	RF	DS	RF	DS	RF
6	IS	NA	RF	NA	IS	NA	RF	DS	RF	IS	RF	DS	RF
7	NA	DS	RF	DS	RF	DS	RF	DS	RF	DS	RF	DS	RF
8	RF	IS	RF	NA	NA	IS	RF	NA	DS	DS	RF	IS	DS
9	IS	NA	RF	IS	RF	DS	RF	IS	DS	DS	RF	DS	NA
10	DS	NA	RF	DS	RF	DS	RF	DS	RF	DS	RF	DS	RF
11	IS	NA	NA	NA	DS	DS	NA	DS	DS	NA	NA	DS	DS

12	NA	IS	RF	NA	NA	IS	RF	NA	DS	IS	NA	DS	NA
13	NA	DS	RF	NA	NA	NA	RF	DS	RF	DS	IS	DS	NA
14	IS	IS	RF	NA	DS	IS	RF	DS	DS	DS	RF	DS	RF
15	NA	NA	RF	NA	NA	NA	RF	DS	DS	DS	RF	DS	IS
16	NA	IS	RF	NA	NA	IS	RF	DS	DS	NA	RF	DS	RF
17	NA	NA	RF	NA	NA	NA	RF	DS	RF	DS	IS	DS	RF
18	IS	DS	RF	NA	RF	NA	RF	DS	RF	DS	RF	DS	RF
19	DS	DS	RF	IS	DS	DS	RF	IS	RF	IS	IS	DS	RF
20	IS	DS	RF	NA	DS	NA	RF	DS	RF	NA	NA	IS	RF
21	IS	NA	RF	NA	RF	NA	RF	DS	RF	DS	RF	DS	RF
22	DS	DS	RF	NA	DS	DS	RF	DS	RF	DS	RF	DS	RF
23	NA	DS	NA	NA	NA	NA	NA	NA	RF	NA	NA	DS	RF
24	IS	NA	RF	NA	RF	NA	RF	DS	RF	NA	NA	DS	RF
25	IS	DS	RF	NA	DS	DS	RF	NA	RF	DS	IS	DS	RF

Notes: DS – *directly supported;* IS – *indirectly supported;* RF – *reformulation required;* NA – *not applicable (a case when an informant, due to various reasons, either avoided to answer or had insufficient experience or information on the issue); * - formulated in Study 2.*

Table 4. Illustrative Quotes Supporting the Propositions

No*	Illustrative Quotes
1a	"Establishing a blockchain network requires collaboration …So during that exercise, of course, you need to have a lot of interaction between different organizations and both stakeholders involved, but if that has been completed, and the network is operating, then the necessity to physically meet each other is of course less" (Case 4)
1b	"[The relationship] gets closer and closer. One area we have seen some clients have this in the area about supply chain financing. A very common example is Walmart, [which] is trying to do something in the space, so Walmart is really tightening that supply chain by putting it on a blockchain with smart contracts so to track movement of goods, to place orders, track the goods moving, make the payments faster. In order to take full advantage of the technologies, Walmart and its suppliers have signing on to join the syndicate commitment to it. That's creating a stronger linkage and bondage between them" (Case 22)
2b	"The new way of interaction, it's digitalized and according to the agreement of the whole supply chain, which makes it very different, because they interact now based not on their own information but based on the transparent ledger and agreement that they all agreed on, that's the main difference" (Case 7)
3a	"Usually paper-based contracts tend to increase interactions at the very end of the dealing phase, so when you're in the very phase of creating a contract to address some kind of relationship. The adoption of smart contracts, especially now that we are at the early stage of that, requires much more interactions and communications in order to prepare the infrastructure and the environment" (Case 9)
3b	"I think that you are more connected because you share the same goal and you will interact with one smart contract, in this case, that's why you will be more connected because you are bound to a smart contract" (Case 5)
4b	"You are becoming more dependent on each other to accept changes, because if one party doesn't join or doesn't accept the changes, basically it's going to basically stop everything … That party should be taken out of the chain of trust basically, but then the whole thing stops, so you need to join in order to make it efficient" (Case 10)
5	"The willingness to participate in the smart contract ecosystem could become a differentiator or an influencing characteristic in which suppliers I choose; if a business doesn't want to engage in the ecosystem because of whatever reason, then I may choose not to work with them" (Case 18) "… once you have the ability to share data in a secure fashion and it's trustworthy, this opens up an opportunity … for the creation of new business ecosystem because you now have the opportunity to create business efficiencies and solutions that draw together competitors" (Case 18)
6a	"… the smart contracts and the clear terminology within the smart contracts as they become stronger and more crisp and clearer will actually unify the language because people will be using that language across, because if you're reliant on smart contracts then you're using the language of that reliance" (Case 21)
6b	"Today if you are talking how blockchain is implemented, how people perceive themselves, if you put blockchain in front of something, you will be perceived as something special, something innovative" (Case 15)

7	"It's always a question of creating an efficient system. When you ever remove inefficiency in areas of the business which are completely automated now, you can recover that work and use it for instance for business development instead of using resources to make low-level activities" (Case 24)
8	"It is a stepping stone for doing that. Because if you are embracing technology where you're all dependent of, then there is a stepping stone to communicate about innovation together" (Case 10)
9	"It could be that the time that is left is used for streamlining other business processes. That's a positive development. A negative development could be that a company starts sitting back [and] thinking: "Well, everything's arranged. Everything's working with a smart contract." There are always two sides to the coin" (Case 11)

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