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Exploring Blockchain Governance

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The Faculty of Business, Economics and Informatics of the University of Zurich hereby authorizes the printing of this dissertation, without indicating an opinion of the views expressed in the work.

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Abstract

Blockchain systems continue to attract significant interest from both practitioners and researchers. What is more, blockchain systems come in various types, such as cryptocurrencies or as inter-organizational systems in business networks. As an example of a cryptocurrency, Bitcoin, one of the most prominent blockchain systems to date and born at the time of a major financial crisis, spearheaded the promise of relying on code and computation instead of a central governing entity. Proponents would argue that Bitcoin stood the test of time, as Bitcoin continues to operate to date for over a decade. However, these proponents overlook the never-ending, heated debates "behind the scenes" caused by diverging goals of central actors, which led to numerous alternative systems (forks) of Bitcoin. To accommodate these actors' interests in the pursuit of their common goal is a tightrope act, and this is where this dissertation commences: blockchain governance. Based on the empirical examples of various types and application domains of blockchain systems, it is the goal of this dissertation to 1) uncover governance patterns by showing, how blockchain systems are governed, 2) derive governance challenges faced or caused by blockchain systems, and, consequently, to 3) contribute to a better understanding to what blockchain governance is.

This dissertation includes four parts, each of these covering different thematical areas: In the first part, this dissertation focuses on obtaining a better understanding of blockchain governance's context of reference by studying blockchain systems from various application domains and system types, for example, led by inter-organizational networks, states, or an independent group of actors. The second part, then, focuses on a blockchain as an inter-organizational system called "cardossier", a project I was involved in, and its governance as a frame of reference. Hereupon, for one, I report on learnings from my project involvement in the form of managerial guidelines, and, for two, I report on structural problems within cardossier, and problems caused by membership growth and how they can be resolved. The third part focuses on a wider study of blockchains as inter-organizational systems, where I summarize findings of an analysis of 19 blockchain consortia. The findings, for one, answer the question of why blockchain consortia adopt blockchain technology, and, for two, show internal and external challenges these systems faced to derive managerial recommendations. The fourth and last part studies blockchain governance's evolution and contributes an analysis of blockchain's governance features and its contrast to established modes of governance.

These four parts, altogether, have scientific value as they increase our understanding on blockchain governance. Consequently, this dissertation contributes to the body of knowledge

on modes of governance, distributed system governance, and blockchain governance in general. I do so, by grounding the concept of blockchain governance in empirical detail, showing how these systems are governed on various application domains and system types, and by studying empirical challenges faced or caused by these systems. This approach is relevant and necessary, as blockchain systems in general, but particularly outside of cryptocurrencies, mostly still are in pursuit of a sustainable blockchain governance. As blockchains can be expected to continue to mature, the upcoming years offer very fruitful ground for empirical research along the empirical insights and theoretical lines shown in this dissertation.

Zusammenfassung

Blockchain-Systeme stoßen sowohl bei Praktikern als auch bei Forschern weiterhin auf großes Interesse. Dabei gibt es Blockchain-Systeme in verschiedenen Ausprägungen, wie z. B. als Kryptowährungen oder als interorganisationale Systeme eingesetzt in Unternehmensnetzwerken. Als Beispiel für eine Kryptowährung steht Bitcoin, eines der bis heute bekanntesten Blockchain-Systeme, welches zur Zeit einer großen Finanzkrise entstand, für das Versprechen, sich auf Code und Berechnungen zu verlassen, anstatt auf eine zentrale Verwaltungsinstanz. Befürworter würden argumentieren, dass Bitcoin den Test der Zeit bestanden hat, da Bitcoin bis heute seit über einem Jahrzehnt funktioniert. Allerdings übersehen diese Befürworter die nicht enden wollenden, hitzigen Debatten "hinter den Kulissen", die durch divergierende Ziele zentraler Akteure verursacht wurden und zu zahlreichen alternativen Systemen (Forks) von Bitcoin führten. Die Interessen dieser Akteure bei der Verfolgung des gemeinsamen Ziels unter einen Hut zu bringen, ist ein Drahtseilakt, und genau hier setzt diese Dissertation an: Blockchain-Governance. Anhand von empirischen Beispielen verschiedener Typen und Anwendungsdomänen von Blockchain-Systemen ist es das Ziel dieser Dissertation, 1) Governance-Muster aufzudecken, indem gezeigt wird, wie Blockchain-Systeme verwaltet werden, 2) Governance-Herausforderungen abzuleiten, denen Blockchain-Systeme gegenüberstehen oder die durch sie verursacht werden, und folglich 3) zu einem besseren Verständnis dessen beizutragen, was Blockchain-Governance ist.

Diese Dissertation umfasst vier Teile, die jeweils unterschiedliche Themenbereiche abdecken: Im ersten Teil konzentriert sich diese Dissertation darauf, ein besseres Verständnis des Bezugskontextes von Blockchain-Governance zu erlangen, indem Blockchain-Systeme aus verschiedenen Anwendungsdomänen und Systemtypen untersucht werden, z.B. geführt von inter-organisatorischen Netzwerken, Staaten oder einer unabhängigen Gruppe von Akteuren. Der zweite Teil konzentriert sich dann auf den Typ einer Blockchain als inter-organisatorisches System am Beispiel des von mir betreuten Projekts "cardossier" und dessen Governance. Dabei berichte ich zum einen über Learnings aus meiner Projektbeteiligung in Form von Führungsleitlinien und zum anderen über strukturelle Probleme innerhalb von cardossier und Probleme, die durch das Mitgliederwachstum entstanden sind und wie diese gelöst werden können. Der dritte Teil konzentriert sich auf eine umfassendere Untersuchung von Blockchains als interorganisationale Systeme, wo ich über die Ergebnisse einer Analyse von 19 Blockchain-Konsortien berichte, wobei ich zum einen die Frage beantworte, warum Blockchain-Konsortien die Blockchain-Technologie adaptieren und zum anderen interne und

externe Herausforderungen dieser Systeme aufzeige, um daraus Managementempfehlungen abzuleiten. Der vierte und letzte Teil untersucht die Entwicklung von Blockchain-Governance im Allgemeinen und liefert eine Analyse der Governance-Merkmale von Blockchain und deren Kontrast zu etablierten Governance-Modi.

Diese vier Teile sind insgesamt von wissenschaftlichem Wert, da sie unser Verständnis von Blockchain-Governance erhöhen. Infolgedessen trägt diese Dissertation zum Wissensbestand über Governance-Modi, die Governance verteilter Systeme und Blockchain-Governance im Allgemeinen bei. Ich tue dies, indem ich das Konzept der Blockchain-Governance empirisch fundiere, indem ich zeige, wie diese Systeme in verschiedenen Anwendungsdomänen und Systemtypen gesteuert werden, und indem ich empirische Herausforderungen untersuche, die durch diese Systeme wahrgenommen oder verursacht werden. Dieser Ansatz ist relevant und notwendig, da Blockchain-Systeme im Allgemeinen, aber insbesondere außerhalb von Kryptowährungen, meist noch auf der Suche nach einer nachhaltigen Blockchain-Governance sind. Da der Reifegrad von Blockchains sich stetig erhöht, bieten die kommenden Jahre ein sehr fruchtbares Terrain für empirische Forschung entlang der in dieser Dissertation aufgezeigten empirischen Erkenntnisse und theoretischen Bezüge.

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1 Research Overview and Synopsis

1.1 Introduction

1.1.1 Context of this Research

“Ruling with many rulers is not easy” (Ziolkowski et al., 2018). Trying to rule without rulers is a paradox in theory with interesting consequences in practice. Both stances manifest in the emerging problems of governance regarding blockchain systems (Ziolkowski et al., 2018). Consider the example of the most prominent blockchain system to date: Bitcoin. Bitcoin, born at the time of a major financial crisis, allowed for the transfer of value without a formal governing entity (Ziolkowski et al., 2018). Thereby, instead of relying on a governing party like a bank, Bitcoin relies on software code and distributed computing (so-called mining). In other words, Bitcoin is a global decentralized information infrastructure developed and maintained by a variety of formally independent actors, whose interests mostly diverge. At the same time, these actors are mutually dependent (Islam et al., 2019; Miscione et al., 2019) as, for example, without maintainers, the system halts; without system developers, the system becomes outdated; without exchanges, trades would be hampered. Consequently, it is a tightrope act to accommodate these actors’ interests in the pursuit of common goals, which is where this dissertation commences: blockchain governance. Within this dissertation, blockchain governance is considered as the ability to get actors to behave as they otherwise would not in order to achieve a common goal, which includes formal and informal power, but also forces like social norms, contingencies, hype, or charisma (Miscione et al., 2019).

The fact that blockchain governance constitutes a challenge is frequently emphasized in academic research (Beck et al., 2018; Hsieh et al., 2017; Rossi, Mueller-Bloch, Thatcher, & Beck, 2019) but also in practice: Bitcoin’s decade long history, for example, is defined by constant crises (De Filippi & Loveluck, 2016a), particularly in relation to never-ending conflicts on core technical decisions (Ziolkowski et al., 2018). Those problems put Bitcoin repeatedly on the verge of a stand-still if not collapse (De Filippi & Loveluck, 2016a). Thereby, Bitcoin only stands as one example among many blockchain projects suffering from similar problems, as it can also be seen in the case of the second largest blockchain project Ethereum (Ziolkowski et al., 2018). These conflicts and eventual setbacks, however, did not hurt the enthusiasm that persists around building sustainably and decentrally-governed information infrastructures like blockchains. Aware of these problems, several blockchain projects started out to improve their governance by implementing processes on how to maintain consensus among themselves. Several of these projects strive to become so-called decentralized autonomous organizations (DAOs: Self-organized communities whose operation is set in code), where three prominent projects alone (Tezos, Aragon, TheDAO) gathered hundreds of millions USD in funds (Ziolkowski et al., 2018). Interestingly, these ran in governance problems shortly after their launch (DuPont, 2017; Floyd, 2018).

Besides open and public blockchains like Bitcoin, blockchain systems are also being tried out as inter-organizational systems (IOSs). One instance of such IOSs are blockchain consortia, who increasingly explore the merits of blockchain technology (Gratzke et al., 2017). Such systems are very different from blockchains like Bitcoin: in contrast to maintaining consensus among many unknown parties (Bitcoin), consensus now must be established among few known parties. An IOS is often cited to be subject to mistrust, overhead costs, or competitive behavior among associated parties (Cao & Zhang, 2011; Daugherty et al., 2006), to which governance brings the means of order (Cao & Zhang, 2011; Fawcett et al., 2015; Walport, 2016). The prospects of blockchain systems as IOSs regard inter alia process efficiency (e.g. automation of expensive authentication processes), product innovations (such as variations of tokens), or traceability of events through the provision of a shared, but commonly governed ledger (Bauer, Zavolokina, Leisibach, et al., 2019; Oliveira et al., 2018).

As it can be seen, blockchain systems are tried out in various contexts, with various prospects, and, thus, various consequences for blockchain governance. As each of these contexts is different, it is necessary to inspect their deeper rationales, to understand the prospects blockchains bring to these contexts, and what consequences for blockchain governance arise. Consequently, it is the goal of this dissertation to

1) uncover governance patterns by showing, *how* blockchain systems are governed,
2) derive governance *challenges* faced or caused by blockchain systems, and, consequently,
3) contribute to a better understanding to *what* blockchain governance is.

In the following, I first define the terms “blockchain systems” and “blockchain governance”. Afterwards, I introduce two central projects to this dissertation, namely the so-called “cardossier” and the “consortia study”. Then, I detail this dissertation’s parts, while concluding with limitations of this dissertation and opportunities for future research.

1.1.2 Fundamentals of Blockchain Systems

Analogous to information systems, which consist of tasks, users, and application systems, I define blockchain systems as a blockchain application systems and their organizational embedment (users and tasks) (Ziolkowski et al., 2020b). Broadly speaking, blockchains constitute an append-only ledger consisting of transactions to which transactions are added following encoded consensus rules in a blockchain protocol. Thereby, blockchain systems rely on the principles of decentralization (no central entity), immutability (transactions cannot be deleted), auditability (traceability of events), and anonymity (key pair authentication) (Zheng et al., 2017a; Ziolkowski et al., 2020b). According to Ziolkowski et al. (2020a), there are several common blockchain types, which, from a technical perspective, can be classified along two axes: access to transactions and transaction validation rights, which leads to either public (public transactions, everyone can validate), permissioned (public transactions, restricted validation), or private (private transactions, restricted validation) blockchains (see table 1 below). As for the examples shown in the previous section, Bitcoin constitutes a permissionless public blockchain, while the majority of IOSs would use permissioned private or permissioned public systems.

	Access to Transaction Validation	
Access to Transactions	**Permissioned**	**Permissionless**
Public	All nodes can read and submit transactions. Only authorized nodes can validate transactions.	All nodes can read, submit, and validate transactions.
Private	Only authorized nodes can read, submit, and validate transactions.	

Table 1. Classification on Blockchain Types, taken from Peters and Panayi (2015)

1.1.3 Governance and Blockchain Governance

The term governance is generally used with different meanings in different application domains (Ziolkowski et al., 2020b). Prominent domains include politics (focal point: state order (Fukuyama, 2013)), IT Governance (focal point: Business-IT alignment (Weill, 2004)), or social sciences (focal point: order of social structures (Chhotray & Stoker, 2009)). At its core, governance describes how order between different parties is established (Williamson, 1985), often referring to the allocation of decision rights, accountabilities, and incentives (Weill & Ross, 2004a). Institutions are an important concept in regard to governance as they structure interactions through the provision of formal constrains (rules, laws), informal constraints (norms of behaviors, conventions), and their characteristics of enforcement (North, 1993). While institutions provide “the rules of the game”, organizations are referred to as “players of the game”, comprising “(…) a group of individuals bound by common purpose to achieve objects” (North, 1990).

Like the term governance, the term blockchain governance is used in blockchain research with various meanings. For example, Beck et al. (2018) see blockchain governance closely related to IT governance in regard to the assignment of decision rights, accountabilities, and incentives. Thereby, Beck et al. focus on the governance of and not through the blockchain system. For another, Pelt et al. (2020) take a broader stance and define blockchain governance as a tool for jointly contributing stakeholders of a blockchain project to achieve coordination, control, and direction. As a last example, Lumineau et al. (2020), see blockchain governance as the governance of transactions. Thereby, they argue blockchains to change how contracting, which is a central element of transacting, is conducted by the use of the blockchain protocol and smart contracts. This argument is in line with ongoing debates, in which blockchains are said to compete with established modes of governance like networks (Powell, 1990), markets, or hierarchies (Williamson, 1975a) by creating their own mode of governance (Allen et al., 2020; Davidson et al., 2016).

In order to accommodate the diversity of use domains that blockchains are or can be applied to (Miscione et al., 2019), within this dissertation, I consider blockchain governance as the ability to get actors to behave as they would otherwise not in order to achieve a common goal (Miscione et al., 2019) (adapted from Stoker (1998)). This broad and relational definition of governance covers formal and informal power, thus different modes of governance like networks (Powell, 1990), markets, or hierarchies (Williamson, 1975a). Further, this definition also allows me to account for other forces not formally covered in modes of governance, such as social norms, contingencies, hype, or charisma, which all proved explanatory in blockchain cases (Miscione et al, 2019). Even though markets, hierarchies, and networks are generic constructs, their underlying features (e.g., property rights and contractual frameworks, normative guidelines, coordination, control, and incentive mechanisms) are helpful in understanding blockchain governance, as I will argue in several papers within this dissertation.

1.1.4 Blockchain Governance Perspectives and Modalities

There are two perspectives and modalities to blockchain governance, which are frequently used in research and which are central to the research conducted in the framework of this dissertation. Aside from the system types shown in table 1, several researchers see blockchain governance from the two different perspectives *of* and *through* (De Filippi & Mcmullen, 2018; Miscione et al., 2018; Ziolkowski et al., 2020a) and enacted in the two different modalities of *on*- and *off*-chain (Hsieh et al., 2017; Reijers et al., 2018), as seen in table 2 below. The perspectives *of* and *through* regard the focus of governance, i.e., either the blockchain system itself (of) or the use-case, in which blockchain systems are embedded (through). For example, the governance *of* the system would include the design of a transaction validation system (as seen in table 1), while the governance *through* the system can be seen on Bitcoin, where a blockchain system takes part in governing the monetary system. On the other hand, the modalities *on*- and *off*-chain regard, in how far the blockchain system is utilized for governance. The off-chain governance layer regards blockchain-agnostic components that facilitate governance of either the blockchain system (e.g., assigning decision rights, responsibilities, or accountabilities to system developers) or the blockchain use-case (e.g., use-case-related decision-making in online communities) (Ziolkowski et al., 2020a). Lastly, the on-chain governance layer regards blockchain-inherent components that govern either the blockchain system (e.g., a transaction validation system, blockchain-based voting) or the blockchain use-case (e.g., governing a monetary system like Bitcoin). Table 2 below shows blockchain governance perspectives and modalities.

		Modality	
		On-chain *Blockchain-inherent*	**Off-chain** *Blockchain-agnostic*
Focus	**Governance of blockchain** *Focus: Blockchain system*	Blockchain-inherent components that facilitate the governance of the blockchain system. **Examples:** transaction validation system, built-in incentive schemes	Blockchain-agnostic components that facilitate governance of the blockchain system. **Examples:** system-centric decision-making in online communities or legal bodies
	Governance through blockchain *Focus: Use-Case*	Blockchain-inherent components that facilitate governance of the blockchain use-case. **Examples:** governing a monetary system through a blockchain system	Blockchain-agnostic components that facilitate governance of the blockchain use-case. **Examples:** use-case-centric decision-making in online communities or legal bodies

Table 2. Governance Foci and Modalities, adapted from Ziolkowski et al. (2020a)

Related to the dissertation goals formulated in section 1.1.1, these two perspectives and modalities prove helpful in explaining the emerging phenomenon of blockchain governance. They do so, as they differentiate between the social and technical layers (adapted from Hsieh et al. (2018)) of blockchain governance and the way these conflate (e.g., encoding organizational functions or processes). In addition, they also account for the context (use-cases) – and, consequently, their contingencies - these blockchain systems are embedded in.

All these perspectives together allow, consequently, to understand, which challenges are faced or caused by blockchain systems. Before explaining this dissertation's structure and detailing its included studies, in the following, I will first briefly introduce two central studies, which were conducted in the framework of my dissertation.

1.1.5 Cardossier Project

One part of this dissertation project is embedded in a larger Innosuisse research project called "Blockchain Cardossier"[1]. Within this project, which I also co-initiated, I was one of four PhD students working on the project, and I was responsible for governance-related works. Cardossier was initiated in 2018 and deals with a consortium of several major stakeholders in the car ecosystem in Switzerland. More specifically, initially, this consortium included a large software company (AdNovum), industry partners (AMAG Import, Mobility, AXA Winterthur, the Road Traffic Agency of the canton of Aargau), and an academic partner (University of Applied Sciences Luzern). This consortium is led by the vision of lowering the information asymmetry between buyers and sellers of cars in the used-car market, which refers to the work of Nobel laurate Akerlof (1970). To do so, as shown in figure 1 below, cardossier is implementing a blockchain-based system to store car-related data over a car's lifecycle, from its import to its disposal. Data, together with basic functionalities are provided in the infrastructural layer. This infrastructure is then utilized to power so-called "dapps" (decentralized applications), which represent use cases, developed within the consortium; while the infrastructural layer and several dapps belong to the commons, dapps can also be developed by and for oneself (private). Lastly, a dapp needs to be integrated into the stakeholder's system. In general, cardossier believes a blockchain-based system to allow for (1) new product offerings, such as an algorithmically verified car history (cardossier dossier), (2) digitizing existing processes among members in the car ecosystem, allowing for operational excellence, and (3) higher customizability of existing products, such as individualized and automatically enforced car insurances. While some of these can be realized by information/process integration among few parties, central to cardossier is the complete "cardossier" (complete record about a car), which is one instance of dapps. The value of such a car record depends widely on the integrity, reliability, and completeness of the information about a car (Miscione et al., 2019). This completeness, however, is difficult to obtain, as a car

[1] This spelling of the project refers to the official Innosuisse research title. Please note, that the spelling of the title of this project varies, and is sometimes even anonymized ("CarCon", "AutoFile"), due to several changes over time throughout this dissertation as it corresponds to the original spelling in the publications.

encompasses numerous actors over its lifecycle, such as insurances, state agencies, or various owners. Consequently, information about a car is structurally fragmented and maintained inconsistently, which leads to various "truths" of a car.

While the cardossier is reoccurring as one of several cases in multiple publications covered in this dissertation, part two of this dissertation specifically focuses on the cardossier. To clarify, in my dissertation, I am not addressing any of the layers shown in figure 1 from a technical perspective. Instead, cardossier-related publications focus on the governance arrangement necessary to provide these layers, e.g., how to ensure a functioning infrastructural/application/integration layer or how to divide along common and private goods.

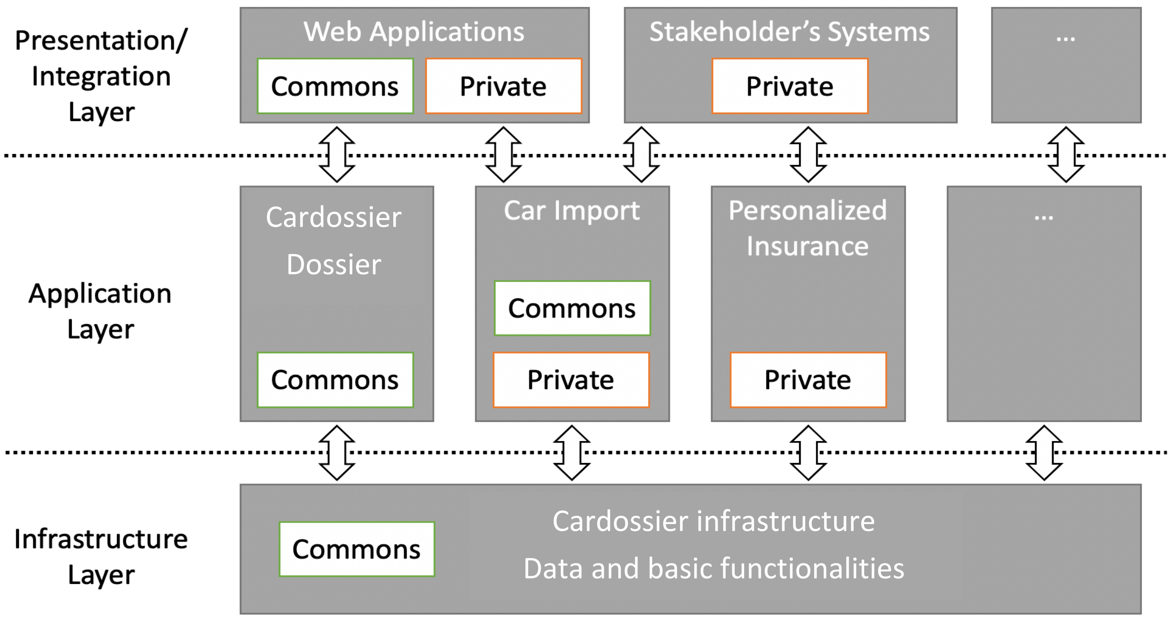

Figure 1. Overall functioning of cardossier

The Innosuisse project lasted for 27 months, starting from October 2017 until December 2019. For the year of 2020, the research team was a member of the cardossier association, which it left by the end of 2020. In preparation for the Innosuisse project, 12 months before the project start, several tasks were conducted, such as project scoping and project planning, development and refinement of the business model, partner acquisition, and preparation of the Innosuisse application. Aside from partner acquisition, which was led by my supervisor and several industry partners, these tasks were conducted collaboratively within the research team and cardossier's project manager from AdNovum. Within the Innosuisse project, I inhered two main roles: For one, I was responsible for the governance-related works, which were specified as a work package in the Innosuisse application. For another, together with my research team, I acted as a business analyst to translate business requirements into technical demands and to design and evaluate cardossier's system. In addition to these main roles, I supported operational activities within the project, such as the preparation and conduct of project meetings. I also marketed the project, as well as developments within the projects, as a speaker in various workshops, seminars, and conferences. Lastly, as interest around the cardossier continued to grow, I was leading activities related to the founding of the cardossier association, including the evaluation of legal body types with senior cardossier stakeholders, defining constituents of cardossier's governance model, and specifying these in the association's statutes. The cardossier association was founded as a legal entity in Switzerland consequently in March 2019. My last activity during my involvement with the cardossier was the refinement of its governance structure, which is covered in part two of this dissertation. Finally, the cardossier went operational in 2020, and its member count continues to grow.

1.1.6 Consortia Study

Another central study in my research, which is covered predominantly in part three of this dissertation, deals with an empirical study and analysis of blockchain consortia. Against the background of how blockchain systems are increasingly tried out in blockchain consortia, we initiated a study in fall 2018 together with the Swiss subsidiary of a global professional services firm and several researchers. The study's goal has been to understand blockchain consortia in more detail and to eventually derive recommendations for managers (driven by the global professional services firm) as well as research insights (research team, supported by several students and theses). Methodologically, we conducted a multiple-case study including 53 qualitative semi-structured interviews with key members of 19 consortia in various industries, such as banking, healthcare, automotive, and public services. To assure a thorough understanding on each of these consortia and to achieve internal validity of the study's findings, we interviewed 2-3 stakeholders per consortium. The interviews, which had an average length of 75 minutes, were conducted between February and September 2019. Overall, we were able to obtain more than 60 hours of audio material. The interviews were conducted in a semi-structured fashion (Myers & Newman, 2007), utilizing a detailed interview guide, which covered (simplified) a consortium's business model, technological architecture of their aspired solution, regulatory challenges, as well as their mode of governance and collaboration, which corresponded to the research team's research interests. The interviews were transcribed verbatim and coded along the topics of the interview guideline. The coding results were discussed during several workshops within the team of researchers and practitioners, who participated in the data collection and analysis.

Within this study, I was responsible for the governance-related parts of the interview guide, codebook, and qualitative analysis of yielded interview material. Further, I helped to establish contacts to blockchain consortia and conducted several interviews with members of blockchain consortia. Overall, our research team worked collaboratively on developing project artefacts along the way, such as the interview guide, or which consortia to interview. This project was led by a senior researcher within our research team, my supervisor, and industry partners. There are several sub-studies, which were conducted in the framework of this larger multiple case study. As for this dissertation, as seen in part three, we were specifically interested to elaborate on reasons on why these consortia deploy blockchain technology as well as internal and external challenges shaping these consortia along their way.

1.2 Overview of Included Studies

1.2.1 Dissertation Structure

This cumulative dissertation[2] is structured along the synopsis (chapter one) and four thematic parts (chapter two to five), where each part consists of 2-3 papers (each paper is a respective subchapter). Please note, that these parts and papers are structured along this dissertation's logic and not chronologically. Overall, in this dissertation, and along these four parts, I,

(1) in the first part, take a wider stance and explore blockchain governance in general (all blockchain system types; perspective: *of* and *through*; modality: *on*- and *off*-chain) based on empirical data on blockchain systems in various application domains,

(2) in the second part, focus on a single blockchain consortium in depth, by building a preliminary and proposing an enhancement of the blockchain governance within the cardossier (permissioned blockchain; perspective: mainly *through;* modality: mainly *off*-chain) to address structural challenges as well as challenges caused by growth in membership,

[2] Please note, that, specifically in this part of the dissertation, mostly the pronoun "I" instead of "we" will be used in order to tell the dissertation from the perspective of the author. The usage of "I" does not indicate that all tasks were conducted individually, which especially accounts for the conduct of the previously described projects. It goes without saying that co-authors, or others mentioned in the acknowledgements, contributed to, or even led these papers or associated works.

(3) in the third part, focus on a variety of blockchain consortia, exploring blockchain governance in blockchain consortia (mainly permissioned blockchain; perspective: *of* and *through; modality:* mainly *off*-chain) for their reason to use blockchain technology and how they were shaped along internal and external challenges, and
(4) in the fourth part, show blockchain governance's evolution and associated pitfalls (all blockchain system types; perspective: *of* and *through*; modality: *on*- and *off*-chain), while contrasting blockchain's mode of governance against existing ones.

I detail these four parts, which can also be seen in more detail in table 3 below, in the following. The first part, titled "Exploratory Contextual Research", includes three peer-reviewed papers and focuses on obtaining a better *understanding* of blockchain governance, *how* these systems are governed (modes of governance), *what* challenges these systems face (decision problems). This part was necessary to identify blockchain system types as well as theoretical concepts with which these could be studied. Consequently, I did not restrict these papers in terms of blockchain governance perspective (*of* and *through*) or modality (*on*- and *off*-chain), and these papers were open to all blockchain system types. The papers' findings show that blockchain systems vary significantly in application domains and types, for example, led by inter-organizational networks, states, or an independent group of actors, (permissionless/permissioned/private). Further, these papers allowed us to establish links to theoretical concepts, such as modes of governance, platforms and infrastructures, trust, and institutionalism, which informed my future studies and papers.

The second part, titled "Building Cardossier's Governance", includes one peer-reviewed paper and one essay focusing on the case of the cardossier and its governance. In contrast to part one, this part takes a narrow stance on blockchains as IOSs and covers one specific instance of a permissioned blockchain system, in which I study certain blockchain governance perspectives and modalities (perspective: mainly *through;* modality: mainly *off*-chain) in depth. As for this dissertation's goals, this part focuses primarily on *challenges* faced and caused by blockchain systems, while it also contributes to the *understanding* of blockchain governance in general. More concretely, the first paper studies cardossier's tensions and evolution along its governance, consortia management, and business value and contributes managerial guidelines for both researchers and practitioners. The second paper shows the outcome of my cardossier stakeholder analysis, which was used to improve cardossier's governance. My results were then related to known concepts, such as common and private goods and principle-agent conflicts, which allowed me to put cardossier's governance challenges in a wider theoretical context. The latter offers researchers established links for studying blockchains in inter-organizational networks.

The third part of this dissertation is titled “Studying Blockchain Consortia” and includes two essays focusing on the emerging phenomenon of blockchain consortia (business networks), where most of these consortia built permissioned blockchains. This part, consequently, complements part two of this dissertation with a wider set of cases, reporting on results of the consortia study introduced in section 1.1.6. Within my analysis of 19 blockchain consortia, my interest lay on both governance *of* and *through* blockchain to understand both system and its corresponding context. In the study design, I anticipated most consortia to be in early stages of development. Consequently, my governance-related analysis revolved mainly around the *off*-chain, and, as far as possible, on the *on*-chain modality. As for the dissertation’s goals, this part specifically focuses on *how* blockchain systems are governed and what *challenges* they face or cause. Thereby, the first paper zooms in on the reasons of why blockchain consortia choose to utilize blockchain technology, to which we contribute new motives. The second paper, then, derives managerial guidelines for managing blockchain consortia, which complements a paper in part two with a larger number of cases. Considering internal and external challenges of blockchain consortia, and their reasons to utilize blockchain technology, allowed me to contribute to a better understanding, which challenges are being faced by blockchain consortia, and how these were met, which affects consortia governance.

The fourth and last part of this dissertation titled “Blockchains As New Modes Of Governance?” includes three peer-reviewed papers. The goal of these papers is to understand blockchain governance’s evolution and its underlying rationales. This is only possible, if features of known modes of governance are understood and the differences to blockchain systems are worked out, which is at the heart of these papers. Thereby, I did not restrict these papers in terms of blockchain governance perspective (*of* and *through*) or modality (*on*- and *off*-chain), and these papers were open to all blockchain system types. Within the greater context of the dissertation’s goals, this part mainly targets the question of *what* is blockchain governance. I contribute to research and practice an enhanced *understanding* of blockchain governance and how it relates to established and emerging modes of governance, what alternative modes of blockchain governance are being tried out, as well as observed effects of these, and how these effects relate to associated theories.

Each of the four parts and their papers make contributions of their own. Collectively, in the framework of this dissertation, they enhance the understanding on blockchain governance in various configurations and application domains, blockchain governance’s evolution and its underlying rationales, and establish necessary links to theory. The following chapters 1.2.2., 1.2.3., 1.2.4., and 1.2.5. detail each paper’s relevance, main findings, and contributions to this dissertation’s goals. Table 3 below provides an overview of this dissertation along its parts, included papers, and summarized contextual information about each paper covering the investigated research question, the relevance of each paper, as well as each paper's contribution.

Part	Paper	Research Questions	Relevance	Findings and Contributions
Part I: Exploratory Contextual Research	**Ziolkowski, R.,** Miscione, G., & Schwabe, G. (2018). Consensus through Blockchains: Exploring Governance across inter-organizational Settings. *ICIS 2018 Proceedings*. 39th International Conference on Information Systems, San Francisco, USA, 12th December 2018 - 16th December.	• How do blockchain-based systems impact governance? • How does their governance relate in practice to established forms of governance as well as platforms and infrastructures?	• Unknown utilization and effects of blockchains on hierarchies and networks • Unclear utilization of the blockchain system (platform vs. infrastructure)	• Blockchain influences auditability, efficiency, human involvement, and data immutability • Blockchains conflate infrastructures and platforms
	Ziolkowski, R., Miscione, G., & Schwabe, G. (2020). Decision Problems in Blockchain Governance: Old Wine in New Bottles or Walking in Someone Else's Shoes? *Journal of Management Information Systems, 37*(2), 316–348. **Note:** Previously published in the Proceedings of the Hawaii International Conference on System Sciences (HICSS), then developed into a journal publication for the Journal of Management Information Systems. The conference publication received the **best paper award**. The final journal version of the publication is included into the dissertation.	• What are major decision problems in blockchain systems? • How are those problems dealt with in practice? • What is the theoretical relevance of blockchain peculiarities?	• Blockchain systems are affected in their functioning by decision problems • Several of these decision problems are known but altered in reference to blockchain technology. • Several decision problems are new and need to be contextualized, to better understand blockchain systems.	• Six decision problems (demand management, data management, system architecture and development, transaction reversal, ownership disputes, membership) and how they are dealt with • Established links of blockchain systems to concepts and theories
	Miscione, G., Richter, C., & **Ziolkowski, R.** (2020). Authenticating Deeds/Organizing Society Considerations for Blockchain-Based Land Registries. *In Responsible and Smart Land Management Interventions: An African Context* (pp. 133–149). CRC Press (Taylor & Francis).	• How can four theoretical angles help to understand land registry governance on the example of Ghana? (not spelled out in the manuscript)	• A blockchain-system-oriented view does not account for blockchain's effects on the use context of land registries	• Establishing linkages (blockchain's affordances and challenges) of four theoretical lenses (institutionalism, neoinstitutionalism, structuration, actor-network-theory) to blockchain systems on the example of Ghana's land registry

Part II: **Building Cardossier's Governance**	Zavolokina, L., **Ziolkowski, R.,** Bauer, I., & Schwabe, G. (2020). Management, Governance, and Value Creation in a Blockchain Consortium. *MIS Quarterly Executive, 19*(1), 1–17.	• What can other blockchain consortia learn from the cardossier in terms of management, governance, and value creation? (not spelled out in the manuscript)	• Blockchains allegedly allow for new types of collaborations among companies • At the same time, blockchain's characteristics introduce various challenges	• Improved understanding on network-type blockchain governance by deriving learnings and tensions on the case of the cardossier
	Ziolkowski, R., & Schwabe, G. (2020). Mine, Yours … Ours? Managing Stakeholder Conflicts in an Enterprise Blockchain Consortium (Essay) **Note:** This paper is being prepared for journal submission.	• Which stakeholder conflicts can be observed within cardossier? • How could these conflicts be resolved by a Blockchain Governance? • How do these conflicts and resolutions relate to Blockchain Governance?	• Blockchains allegedly allow for new types of collaborations among companies • Understanding stakeholders as precondition for better governance	• Improved understanding on network-type blockchain governance by establishing links to various concepts and theories (principle-agent, sectorial, and competition conflicts, as well as conflicts around private and common goods) on the example of the cardossier
Part III: **Studying Blockchain Consortia**	Bauer, I., **Ziolkowski, R.,** Hacker, J., & Schwabe, G. (2021). Why Blockchain? (Essay) **Note:** This paper is being prepared for journal submission.	• What are the motives of business consortia members for using blockchain technology? • What makes blockchain unique to justify engagement with it?	• "Why Blockchain?" a controverse question within blockchain research • Diffusion between technical and economical motivations to use blockchain technology	• 19 motives of why companies engage with blockchain technology based on the results of a larger study • Established link to the concept of an information systems and the centrality of information
	Ziolkowski, R., Kohler, N., Hacker, J., Schwabe, G. (2021). Managing Blockchain Consortia (Essay) **Note:** This paper is being prepared for journal submission.	• Which internal and external challenges do blockchain consortia face?	• Blockchain consortia deal with internal and external challenges, which impede their	• Derived 17 recommendations for dealing with blockchain consortia • Established links to challenge areas around governance of

		• How do blockchain consortia respond to these challenges?	functioning and evolution	network-type blockchain systems
Part IV: Blockchains As New Modes of Governance?	Miscione, G., **Ziolkowski, R.,** Zavolokina, L., & Schwabe, G. (2018). Tribal Governance: The Business of Blockchain Authentication. *Proceedings of the 51st Hawaii International Conference on System Sciences*. 51st Hawaii International Conference on System Sciences, Oahu, Hawaii, USA, January 3rd - January 6th.	• How does blockchain governance differ from free-and-open-source system governance? (not spelled out in the manuscript)	• Misbelief of governing blockchains in the same way as FOSS impacted functioning and evolution of blockchain systems • Understanding blockchain's governance peculiarities helps to improve governance	• A proposal of the "tribal" governance archetype, contrasted against markets, hierarchies, networks, and the "bazaar" on central characteristics of these
	Miscione, G., Klein, S., Schwabe, G., Goerke, T. M., & **Ziolkowski, R.** (2019). Hanseatic Governance: Understanding Blockchain as Organizational Technology. *ICIS 2019 Proceedings*. 40th International Conference on Information Systems, Munich, Germany, 15 December 2019 - 18 December. **Note:** This publication is being extended to be submitted to a journal.	• What are the peculiarities of consortia blockchain governance? (not spelled out in the manuscript)	• Current blockchain governance models have limitations • When blockchains are governed through consortia (networks), blockchain's characteristics necessitate a specific arrangement	• A proposal of the "hanseatic" governance archetype, contrasted against markets, hierarchies, networks, and the "bazaar" on central characteristics of these • Blockchains should be seen as organization instead of information technologies
	Ziolkowski, R., Miscione, G., & Schwabe, G. (2020). Exploring Decentralized Autonomous Organizations: Towards Shared Interests and 'Code is Constitution.' *ICIS 2020 Proceedings*. 41st International Conference on Information Systems, Hyderabad, India, December 13th - December 16th. **Note:** This publication is being extended to be submitted to a journal.	• How are Aragon, Tezos, and DFINITY governed in terms of coordination, control, and incentivization? • What can we learn from Aragon, Tezos, and DFINITY in regard to blockchain governance?	• Current blockchain governance models have limitations • DAOs as alternative ways of governing blockchains; what's new with DAO Governance is unclear	• Study of three large DAOs, depiction of their status quo • Establishing links to associated concepts and theories (IT Governance, trust, generativity)

Table 3. Overview of Conducted Studies

1.2.2 Part I: Exploratory Contextual Research

This part of the dissertation includes three papers that take a wider stance and explore blockchain governance in general (all blockchain system types; perspective: *of* and *through*; modality: *on*- and *off*-chain) based on empirical data on blockchain systems in various application domains. These three papers contribute to all three dissertation goals, exploring *how* these systems are governed, *what* challenges these systems face, and obtaining a better *understanding* of blockchain governance.

The first paper explores the modes of governance of 15 blockchain systems and their system types. I contribute with this paper a better understanding of governance in blockchain systems and effects they face or cause. The second paper, then, takes a narrow focus on decision problems and decision-making as central parts of governance. This paper contributes six empirical decision problems and their context as well as theoretical learnings based on our observations. Lastly, the third paper studies the context of land registries in Africa and the consequences of the use of blockchain technology in this domain. This paper shows the relevance of four theoretical lenses to study blockchain systems. I detail these papers in the following.

1.2.2.1 Consensus Through Blockchains: Exploring Blockchain Governance across inter-organizational Systems

At the time of writing this paper, blockchain governance research focused on public and permissionless systems, especially Bitcoin and Ethereum. At the same time, blockchains were increasingly applied to other use cases than cryptocurrencies, more specifically, as IOSs. The governance of cryptocurrencies (which we labeled "tribal") stands in contrast to IOSs (networks/hierarchies), where collaboration among companies is considered challenging due to, for example, inter-firm rivalry, own interest, or lack of trust. In how far blockchain principles of disintermediation, automation of processes, or cryptocurrencies' "tribal" governance to accommodate mutual interests would apply to such systems was unclear. This new context opened a research gap for a deeper understanding on how blockchain systems were utilized, how they are governed, and what impacts on governance they face or cause in these. To fill this research gap, and by that also improve also the practice of governance in different domains, I conducted a qualitative data analysis based on both transcriptions of 18 semi-structured expert interviews with stakeholders, who aim to implement blockchain-based systems, as well as complementary scientific and grey literature, which has been used for data triangulation. For my analysis, I utilized two established lenses: modes of governance (markets, hierarchies, networks) to understand, if and how blockchain technology would affect these, and the dichotomy of platforms and infrastructures to understand these system's types.

This paper primarily contributes to two dissertation goals, *how* these systems are governed and *what* challenges these systems face or cause. As for the former, studying these cases through the lens of modes of governance and platforms and infrastructures brought several insights: I found evidence of blockchains being used in hierarchical (land registry), network-type (supply chains), and tribal (cryptocurrencies) settings, utilized either as infrastructures (land registry/cryptocurrencies), platforms (supply chains), or both (supply chains). Consequently, I have shown (1) how blockchain-based systems can act as catalysts for digitization and efficiency gains (Land Registry), (2) how they provide efficiency gains in inter-organizational collaboration by automating business logic (CarDossier), and (3) how they can provide governance without a de facto steering body (Cryptocurrencies).

For two, this paper addresses the need of understanding empirically, how blockchain systems cause governance challenges in their respective use contexts (perspective: *through*). This links to this dissertation's goal of understanding blockchain governance challenges faced or caused by blockchains. Our analysis yielded the following blockchain governance challenges:

- sharing the audit for accountability (publicity of records allows for decentralized audit, collaboration with other parties)
- efficiency gains (automating organizational functions through smart contracts, which are immutable/unstoppable)
- data immutability as a deterrent of fraud (mitigating the 'garbage-in-garbage-out'-problem with data immutability), and
- system evolution (tension between immutability and necessary changes).

Consequently, this paper offers a novel contribution to the body of knowledge on *how* blockchain systems are governed (platforms vs. infrastructures, markets vs. hierarchies vs. networks), and which blockchain governance *challenges* (consequences of system types and governance modes) were observed empirically.

1.2.2.2 Decision Problems in Blockchain Governance: Old Wine in New Bottles or Walking in Someone Else's Shoes?

Building up on the previous paper, which deals with the wider frame of modes of governance, I was interested subsequently, which empirical challenges are faced by blockchain systems (all blockchain system types; perspective: *of* and *through*; modality: *on*- and *off*-chain). More specifically, I focused on decision problems as decisions are a central part of governance frameworks. This research has been motivated by the fact that blockchain systems, problems they faced, and consequences of these problems were often declared novel by default. I challenged this position with this paper. Furthermore, instead of relying only on academic research, I saw a better understanding of problems in practice, and possible links to known ways of solving them, as a helpful contribution to practitioners and researchers. Consequently, this paper firstly addresses the question of what major decision problems there are in blockchain systems, how these problems are dealt with in practice, and what theoretical relevance they raise. This research relies widely on the same interview data and grey literature described in 1.2.2.1. The methodological steps, especially the coding framework, were adapted to derive decision problems based on academic literature and empirical findings.

This paper contributes to all three dissertation questions. As for the question, of *what* blockchain governance is, I contribute six empirical decision problems (demand management, system architecture and development, transaction reversal, ownership disputes, membership, and data management). To better understand these problems, I linked these six decision problems to their root problems (abstract problem), and I have shown solutions to these from the blockchain domain (domain solution). As for the dissertation question of *how* these systems are governed, I have shown the enactment of these decision problems in each of the studied cases. This links to calls for research to uncover the inner workings of blockchain collaborations, and, in fact, my research has shown the centralization of decision rights on few actors within these.

Lastly, as for the dissertation question of *what* challenges blockchains face or cause, I was interested in the theoretical consequences of my observed six decision problems and how these were dealt with in practice. My analysis from the observations from these cases revealed several links to major organizational theories in what I labelled "Patrolling the borders", "External Legitimation", "Reduction of Discretionality", and "Temporal Management". More concretely, my theoretical findings can be synthesized as follows (simplified):

1. The redefinition of borders and tools for their patrolling marks a major difference from the so-called "bazaar" mode of governance (Demil & Lecocq, 2006) without falling back onto existing conceptualizations. The blurring of the distinction between agency and context questions a basic assumption of cybernetics (Beer, 1966; Wiener, 1948).
2. Legitimacy does not come from inside or outside organizations, but is an ad hoc network-dependent arrangement produced by the parties involved, each with own context of reference. This exceeds the concept of context in Institutional theories.

3. While the reduction of discretionality, and the loathed politics, may be aimed at making the world fairer and more predictable, the cautionary tales of tightly coupled systems should raise a red flag and encourage a more critical approach to the consequences in practice of blockchain systems. On the side, the design challenge of creating more loosely coupled systems while preserving some blockchain peculiarities is open.
4. Timestamping and immutability are the peculiar features the blockchains bring about. As for tightly coupled systems, the theoretical challenge is in how those systems play out in practice and interact with organizations and society in relation to aspects that elude design, like long-term longevity.

As a summary, the identification of these problems, the way they have been enacted, as well as consequences arising from those enrich the scarce body of knowledge along this dissertation's goals on *how* these systems are governed (enactment of decision problems), which *challenges* are faced or caused by blockchain systems (theoretical points above), and *what* blockchain governance is (focus: decision problems).

1.2.2.3 Authenticating Deeds/Organizing Society Considerations for Blockchain-Based Land Registries

The last paper of the contextual exploratory research deals with establishing several possible research lines for studying blockchain-based systems for land registries (all blockchain system types; perspective: *through*; modality: *on*- and *off*-chain). The goal is thereby not to study one specific blockchain-based system, but to understand how a blockchain-based system will possibly affect organizations and society (perspective: *through*) on the empirical example of – and given the specificities in – Africa. So, within this paper, I show how various theoretical lenses can be utilized to explain blockchain specificities, referring to neoinstitutionalism, structuration theory, and actor-network theory. Aside from establishing these theoretical links, I also discuss common prospects of blockchains in land registry systems, for example, cross-jurisdictional issues, longevity of records, or relevance of transparency and immutability in low trust settings.

This paper contributes to the understanding of applicable theories to blockchain systems, while also showing potential benefits, but also limits of blockchain technology in land registry systems. Thereby, I show which blockchain governance *challenges* blockchain systems bring or cause (specificities in Africa respectively in land registry systems). These theoretical lenses encourage a more nuanced understanding of unconventional contexts of technology in use. This allows us to derive better recommendations than those based on frameworks, which may overlook specificities of developing countries.

1.2.3 Part II: Building Cardossier's Governance

This part of the dissertation includes two papers focusing on building a preliminary blockchain governance and thereafter proposing an enhancement to it within the cardossier (permissioned blockchain; perspective: mainly *through;* modality: mainly *off*-chain) to address structural challenges as well as challenges caused by growth in membership. The cardossier is a re-occurring case throughout other papers in this dissertation, so governance-relevant aspects are only partly covered here. These two papers contribute to all three dissertation goals, exploring *how* these systems are governed, *what* challenges these systems face, and obtaining a better *understanding* of blockchain governance.

In the first paper, I describe my learnings from the cardossier from my two-year-long involvement along its management, governance, and value creation for a practitioner audience. My main contribution is the formulation of learnings for the management of blockchain consortia for other consortia managers. In the second paper, I am focusing on stakeholder conflicts within the cardossier. The complexity of the cardossier's organizational arrangement made it necessary to analyze its stakeholders in more detail. In this second paper, I report from my findings of a stakeholder analysis conducted in collaboration with senior stakeholders.

1.2.3.1 Management, Governance and Value Creation in a Blockchain Consortium

Within this paper, I addressed the cardossier in-depth, building on my over two-year long involvement. Specifically, I study the cardossier from the perspectives of value creation, management, and governance. In a second step, I conceptualize these insights from my involvement into tensions and, subsequently, learnings, which can be possibly applicable to other blockchain consortia. This paper was motivated by the fact that blockchain consortia were increasingly being tried out, and cardossier could be considered as far advanced in comparison, which makes governance – rather than technical issues – prominent. Consequently, cardossier's progress not only accounts for its technological development, as I was also able to provide insights on the organizational activities, which were necessary to set up and run a blockchain consortium in the long-term (perspective: *of*; modality: *off*-chain). Second, I was interested in grounding my observed prospects of blockchain technology as an IOS into more theoretical context. Therefore, my findings are relevant to both research and practice. This paper is based on our experiences and data retrieved from project meetings, participant-observer notes from meetings and workshops, and interviews with senior stakeholders.

Three insights were derived in the paper, which relate to all three goals of this dissertation in, exploring *how* these systems are governed (cardossier's off-chain arrangement), *what* challenges these systems face or cause (tensions, how these were resolved), and obtaining a better *understanding* of blockchain governance (network-type governance). My learnings can be synthesized as follows (taken verbatim from the publication):

1. *Blockchain Solutions Encourage Collaboration, but Require Initial Mutual Trust*

The reasons for enterprises engaging in blockchain-enabled inter-organizational collaboration include curiosity and interest in a new technology, its promised business benefits (trust, transparency, and efficiency resulting in cost savings), fear of missing out or being disrupted, and access to new forms of collaboration. This paper has shown that one form of collaboration is to join a blockchain consortium. However, mutual trust within the consortium is an important aspect to achieve success in this collaboration. Thus, when deciding whether to join a consortium, digital transformation leaders should seek answers to the following questions: Who are the collaborators? Are they ready to shift their mindset to create a common good that can also bring benefits to individual consortium members in the longer term? Are they ready to share financial costs and intellectual property rights? What does the collaboration mean for their organizations?

2. *Blockchain Technology Enables Distributed Value Generation in a Digital Ecosystem*

Permissioned blockchains provide an opportunity to transfer market principles and rules from the physical to the digital world, thus, enabling distributed value generation in a digital ecosystem. Blockchains, per se, do not eliminate competition or create a monopoly. A blockchain platform where players know each other allows a more transparent and trusted environment in which each player can conduct its daily business, create a competitive advantage in the market and provide value for its customers. Although the ecosystem around a blockchain can only be created collaboratively, each enterprise in a blockchain consortium can gain individual benefits from the technology. Achieving these individual benefits, however, requires a clear separation of long-term and short-term priorities and market orientations. Initially, consortium members should focus on resolving inter-organizational efficiency problems (i.e., a business-to-business market orientation) and only later address the business-to-consumer and consumer-to-consumer markets.

3. *Laws and Regulations are Key to the Success of Blockchain Projects*

Blockchains authenticate data and transactions and allow the transfer of digital value, functions that traditionally are governed by legal regulations. Laws and regulations can enable and drive blockchain innovation but can also hinder it. Regulators can play different roles in a blockchain consortium. They can act as supporters who transfer the regulatory requirements into the development, as gatekeepers who control and incentivize data quality, or as orchestrators who enable and intervene in situations that require settlement. Moreover, a blockchain consortium should be established as a legal entity, which will facilitate the combination of on-chain and off-chain governance functions and foster market penetration and standardization. Although some governance functions may be "outsourced" to blockchain code (in the form of smart contracts), making them more efficient, the reality is that off-chain governance is still needed where the technology reaches its limits. At first glance, collaborating through a blockchain consortium might seem to be primarily concerned with the technology itself, but governance and legal considerations play an important role and cannot be ignored.

1.2.3.2 Mine, Yours … Ours? Managing Stakeholder Conflicts in an Enterprise Blockchain Consortium

Within this paper, I inspect cardossier's stakeholder conflicts, which were already existing or caused by an increasingly complex organizational arrangement due to growth in membership. I portray cardossier's stakeholder conflicts, propose solutions for these conflicts, and relate them to literature on blockchain governance. My findings contextualize several theoretical stances for blockchain governance, while emphasizing the importance of the organizational embedment of blockchain technology over technical-oriented stances. Consequently, this paper focuses primarily on the off-chain governance perspective of a network-type blockchain system (permissioned blockchain). This paper follows the methodology of action research, comprising the phases of diagnosing (necessity of improved governance), action planning (focus group), evaluating (expert interviews), action taking (implementation of plan), and specifying learning (research paper), with two cycles of action taking and evaluating.

Within my findings, I categorized cardossier's stakeholder conflicts along the categories of conflicts on competition, principle-agent conflicts, regulatory conflicts, and conflicts on private and common goods. Along with an improved understanding on these stakeholder conflicts in blockchain consortia, this paper contributes several discussion points, which enhance the understanding of agency, regulation, commons, and competition within blockchain consortia. Thereby, this paper contributes to two of this dissertation's goals, namely obtaining a better *understanding* of blockchain governance (network-type governance) and *what* challenges these systems face or cause (various conflicts depicted above, relevance of “the tragedy of the commons” for blockchain systems).

1.2.4 Part III: Studying Blockchain Consortia

Within the third part of this dissertation, I explore blockchain governance in consortia for consortia’s reasons to use blockchain technology and how they were shaped along internal and external challenges. I report from two papers the research team has conducted in the framework of the study described in section 1.1.6. Thereby, most of these consortia built permissioned blockchains. My interest lay on both governance *of* and *through* blockchain to understand both blockchain systems and their corresponding contexts. In this study design, I anticipated most consortia to be in early stages of development. Consequently, my governance-related analysis revolved mainly around the *off*-chain, and, as far as possible, on the *on*-chain modality. As for the dissertation’s goals, this part specifically focuses on *how* blockchain systems are governed and what *challenges* they face or cause.

In the first paper, I addressed the re-occurring question of “Why Blockchain?”. Blockchain technology has been often labeled as a solution searching for a problem. In addition, the choice for or against blockchain technology is often reduced to technical characteristics. Against this background, I challenged these views by analyzing 19 blockchain consortia for their reasons to deploy blockchain and conceptualized 19 high-level motives and allocated these in a wider framework of an information system. The second paper was motivated by challenges these consortia were facing. By analyzing these consortia’s internal as well as external challenges, I was able to derive learnings for managers of blockchain consortia.

1.2.4.1 Why Blockchain?

The question of “Why Blockchain?” is provocative and has its origin in the hype around blockchain systems. Decision models, developed by prior research, enable to evaluate the necessity of blockchains form a technical perspective, often leaving out the respective organizational contexts. Consequently, based on a qualitative bottom-up analysis of interviews with 53 stakeholders, I find that an evaluation with a focus on technical aspects alone is not sufficient, and that the reasons for deploying blockchains go beyond the technical necessity. As indicated above, in this paper, I do not restrict my analysis to system types, while mainly studying *off*-chain, and, as far as possible, *on*-chain blockchain governance modalities. As for this research’s methodology, I adopted a multiple case design and performed a cross-case analysis of qualitative data, which allowed me to increase validity and generalizability of exploratory findings.

My analysis reveals 19 high-level motives for blockchain consortia to adapt blockchain technology: experimentation, opportunity seeking, domain-specific problems and needs, decentralization, uniqueness, control, collaboration, commons, trust, tokenized assets, tokenized services, innovation, efficiency, customization, domain-specific solutions, capability development, financing, marketing, and partnering. In this paper, I position my insights into the context of interorganizational systems, while coining the term blockchain information systems, which allows me to account for the centrality of information in blockchain systems. This research concludes that the question of blockchain adoption is rather a question of power, control, and trust, than a question of technical feasibility. Consequently, as for the dissertation's goals, this part specifically focuses on *how* blockchain systems are governed (norms and/or beliefs to engage with blockchain systems).

1.2.4.2 Managing Blockchain Consortia

This second paper titled "Managing Blockchain Consortia" addresses the issue of blockchain consortia facing several challenges, from an internal and external perspective. Thereby, as these consortia mature and start to put first products on the market, it is now a promising time to reflect on the challenges along their way to help other consortia to thrive. As this paper has been written for a practitioner-oriented outlet, my goal is to derive recommendations for managers of blockchain consortia or parties interested in joining blockchain consortia. Thereby, I develop actionable insights by understanding and contextualizing the ongoings in and around blockchain consortia (perspective: *of* and *through*), based on the same dataset as paper 1.2.4.1 in the framework of a qualitative data analysis. To better conceptualize internal and external challenges, I reviewed several possible frameworks, such as PESTEL or Porter's five forces. To account for the empirical findings, I developed my own framework bottom-up and analyzed the data accordingly.

My insights show that blockchain consortia face internal challenges in the areas of governance, building together, membership, and commons, and for the external perspective in the areas of legal, trust, hype, and competition. My analysis allowed me to derive 17 challenges within these areas, and corresponding recommendations for managers. Consequently, this paper feeds into this dissertation's goals of exploring, which *challenges* blockchain systems face (e.g., data protection laws or hype) or cause (e.g., legal challenges around tokens or around membership arrangements).

1.2.5 Part IV: Blockchains as New Modes of Governance?

The fourth and last part of this dissertation deals with blockchain's claims of proving itself as a new governance mode and consists of three conducted papers. In these papers, I show blockchain governance's evolution and associated pitfalls, while contrasting blockchain's mode of governance against existing ones. Therefore, I did not restrict these studies in terms of blockchain governance perspective (*of* and *through*) or modality (*on*- and *off*-chain), and I was open to all blockchain system types. As for the dissertation's goals, this part mainly targets the question of *what* is blockchain governance, with special focus on blockchain governance constituents. I contribute to research and practice an enhanced *understanding* of blockchain governance and how it relates to established and emerging modes of governance, what alternative modes of blockchain governance are being tried out as well as observed effects of these, and how these effects relate to related theories.

In the first paper, which has been the first to be conducted within this dissertation, I addressed the difference between the modes of governance between free and open-source software (FOSS) development and blockchain systems by zooming in on blockchain's authentication function. Based on the empirical case of land registries, I distilled major differences between the FOSS mode of governance against blockchain's. While the former had a stronger emphasis on public and permissionless blockchains, in the second paper titled "Hanseatic Governance: Understanding Blockchains as Organizational Technology", I extend the differences between blockchains and other modes of governance with a stronger emphasis on the network-blockchain type, which I argue on the case of the cardossier. In the last paper of this dissertation, I analyze blockchain governance's evolution by showing, how permissionless blockchains evolve and how future governance challenges are aimed to be resolved through on-chain functions. I thereby use the empirical examples of decentralized autonomous organizations and distill several critical insights on their developments.

1.2.5.1 Tribal Governance: The Business of Blockchain Authentication

Within this paper, I address one of blockchain's main functions: authentication. While information technologies are increasingly exceeding the boundaries of organizations, governance in relation to IT is gaining centrality for research as much as for practice. Based on interviews with representatives from blockchain companies and content analysis of grey literature, I discuss established modes of governance against the rivalry that cryptocurrencies and blockchains bring to digital settings. Thereby, I studied a few targeted public and permissioned systems in the domain of land registries, while covering in my analysis the perspectives of governance *of* and *through* as well as the modalities of *off*- and *on*-chain. After referring to market, hierarchy, network, and bazaar, I conclude outlining the prospects of a different governance mode called 'tribal' that better captures blockchain's mutual dependency (Miscione et al., 2018). My analysis allows me to deduct the following central differences between blockchain governance and the bazaar mode of governance (taken verbatim from the publication):

- Contrary to open-source licenses that prevent anyone to appropriate the "matter of trade" (i.e., the developed software), public ledgers introduce authentication into digital settings. So, we move from 'carrots and rainbows' to rivalry;
- While in FOSS projects the majority cannot enforce its decisions onto everyone, because anyone can fork their own version relying on publicly available code at low cost while preserving their own use value, in blockchain matters majority decisions are enforced and forking poses substantial costs on all users;
- Cryptocurrencies or other built-in blockchain rewarding schemes affect people's involvement not least because they trade and hoard tokens. This is not a feature of other FOSS projects;
- Derived from the previous points, blockchains manifest a level of mutually dependent interest, thus organizational togetherness, that the bazaar idealtype does not account for.

Furthermore, I see several limitations of the bazaar mode of governance (taken verbatim from the publication):

- Rivalry originates a sense of togetherness which FOSS does not have because exiting/forking is far less damaging (at the same time this is not a network because identities are not fixed, and membership is volatile);
- Its low control intensity does not apply because, even if it remains true that blockchain software can be easily modified as any other FOSS, those changes are not relevant for authentication until they substitute the current software version run by miners and users;
- Thus, the ability to choose and maintain own versions of software may affect but does not define blockchain-related issues and their capacity to mobilize human and technical resources, and also commit them over long periods of time;
- Rather than a product, which is always under development, blockchains are better conceptualized as a means of governance for what they authenticate and how.

Consequently, this paper contributes to this dissertation's goal of understanding, *what* blockchain governance is, as I contrast empirically observed governance features (e.g., contract framework, normative basis, or incentive/control mechanisms) against existing and well-established modes of governance.

1.2.5.2 Hanseatic Governance: Understanding Blockchains as Organizational Technology

Within this second paper titled "Hanseatic Governance: Understanding Blockchain as Organizational Technology", I was interested in grounding my empirical insights from the cardossier, DAOs, and land registries in a wider theoretical frame, with an emphasis on the findings from the cardossier (network-type blockchain system). Consequently, I was open to all types of blockchain systems and did not restrict my analysis in governance perspective or modality. On the theoretical counterexample of the FOSS mode of governance, I distilled several features, which describe blockchain governance, and illustrated thereby blockchain governance's similarity to the concept of "The Hanse", which needs to mediate between the fluidity typical of FOSS development and the immutability that use organizations adopt blockchain for (Miscione et al., 2019). My findings can be synthesized as follows (taken verbatim from the publication):

- While in the bazaar the majority cannot enforce its decisions onto everyone, because anyone can fork their own version relying on publicly available code at low cost while preserving their own use value, in blockchain matters majority decisions are enforced, and forking poses substantial problems to both developers and maintainers;
- Contrary to open source licenses that prevent anyone from appropriating the 'matter of trade' (i.e. software code) because anyone can copy and use the same artefact, public ledgers introduce authentication and thus scarcity into digital settings. Traceability of all actions on the ledger act as a deterrent from breaking the rules. So, blockchains move from 'carrots and rainbows' (von Krogh et al. 2012) as main incentives, to a 'gentle rivalry' within a consortium like the cardossier (Ziolkowski et al. 2019);
- The uncertainty about tomorrow puts more pressure on what is done today because forking later on would be troublesome. Consortia-based projects do not assume the possibility of future-proof complete contracts, but rely on existing legal arrangements according to which all partners are tied together by mutual dependency.

In a nutshell, the contribution of this paper is that Hanseatic Governance is a mediation between the openness of the bazaar and the immutability of distributed ledgers (Miscione et al., 2019). Consequently, this paper contributes to this dissertation's goal of understanding, *what* blockchain governance, with an emphasis on network-type blockchain systems such as the cardossier, is, as I contrast empirically observed governance features and challenges (e.g., path dependency or assigning and enforcing property rights) against existing and well-established modes of governance.

1.2.5.3 Exploring Decentralized Autonomous Organizations: Towards Shared Interests and 'Code is Constitution'

Within this last paper of this part and dissertation, I zoom in on the emerging phenomenon around DAOs. This paper was motivated by the fact that, even though scholarly interest research on blockchain technology steadily increased and the underlying technology matured, observed problems in the field have shown that questions of governance remained crucial, even though scarcely studied empirically. DAOs thereby strove to do better by encoding necessary organizational functions, which would then constitute a new type of organizing that is grounded on consensus-based, distributed autonomy (Ziolkowski et al., 2020a). Consequently, this paper focuses primarily on public and permissionless systems, while it does not restrict either blockchain governance perspectives or modalities. Even though DAOs were around for years, with the most prominent case of TheDAO, the governance of other DAOs was unexplored. Consequently, I launched an exploratory multiple case study consisting of the three popular DAOs Aragon, Tezos, and DFINITY, and analyzed these in the framework of a qualitative data analysis. In the context of an on-and-off-chain continuum, it appears that DAOs provide mechanisms that might enable autonomous decision-making but, at the same time, find themselves strongly influenced by the interests of various stakeholders (Ziolkowski et al., 2020a). Consequently, this paper contributes to this dissertation's goal of understanding, *what* blockchain governance, with an emphasis on public and permissionless blockchain systems such as DAOs, is, as I contrast DAOs' functioning and promises against empirical observations. My results and links to theoretical concepts, which form this paper's contribution, can be summarized as follows (taken verbatim from the publication):

- DAOs are not gatherings of smart contracts, but socio-technical ecosystems consisting of mutually dependent parties. Organizational processes are thereby increasingly ingrained and enacted on-chain, blurring the division between systems and organization.
- Even though motivated by strong enthusiasm, funds, and beliefs, DAOs face several inhibitors to decentralization and autonomy; it remains interesting, why these projects

have not originated generativity (Zittrain, 2006), yet. One could argue that these DAOs may become the victims of their financial successes where, instead of experimenting freely on a large scale, legal issues or public feuds take center stage.

- Human intervention in DAOs is being displaced, transformed, but not marginalized. Instead of achieving autonomy, the DAOs showed the reliance on several central actors acting as gatekeepers, administrate funds, or to accumulate expertise, which reintroduces trust into a system, which was repeatedly considered trust-free.
- Shortcomings of “Code is law” are met with “Code is Constitution”, where the studied DAOs show mechanisms to change fundamental processes, when need arises. As a consequence, blockchain’s immutability, one of its core characteristics, is questioned.
- DAOs need to invest heavily up-front in governance structures, while their infrastructures find limited use, which draws similarities from studies on the Internet and their bootstrap problem. Without considering infrastructure in practice, these upfront costs pass unseen, while only promises of more efficient transactions through smart contracts are highlighted, as several authors argue.

1.3 Conclusion, Limitations, and Future Work

Each of the papers shown in this dissertation has a contribution of its own but the dissertation as a whole is one of the first to explore blockchain governance on this scale: it does not only cover a variety of types and a high number of cases, but also zooms in on selected ones (e.g., Bitcoin, blockchain Consortia or DAOs). Thereby, I contextualize governance challenges faced in these cases, develop theoretical links either to understand their challenges in context or to inform solution design, and derive managerial recommendations for researchers and practitioners. I relate my findings to various concepts such as trust, institutional economics, generativity, legitimation, or control.

I show the limitations of each individual paper in its respective publications. In the following, I focus on the limitations of this dissertation, which, I hope, might inspire researchers to further expand the body of knowledge on blockchain governance.

Variety of cases and generalizability. This dissertation studied over 30 cases, in which blockchain systems were to be developed or already operational. These cases were mostly blockchain consortia, several public and permissionless systems such as Bitcoin, and few targeted DAOs. Each of these have their own context of reference, even within these categories. To make conclusive statement about blockchain governance in each of these categories, a deeper analysis would be necessary. Consequently, my findings should always be seen in the context of the studied cases and may have limited explanatory power outside of these. To study these domains in-depth has not been the goal of this dissertation, which rather aimed to understand the emerging field of blockchain governance as a whole and to establish necessary theoretical links, where appropriate. Nevertheless, I believe each field on its own – public blockchains, DAOs, or blockchains as IOS – to be very promising fields for future research, even beyond the domain of blockchains: decentralized organizing and governance as well as distributed systems are not new and, based on the observed governance challenges in this dissertation, combining these established research streams with blockchain's novel one is a promising venue.

Governance in practice and over time. While most of the public blockchains and DAOs I have studied were operational, most of my studied consortia were not. This is because the phenomenon of blockchain consortia emerged later than most other types of blockchain projects. As governance and associated challenges emerge more clearly in practice and over time, it remains to be seen, in how far my findings will hold, and in how far the scope of the studied projects – and, consequently, the scope of an adequate governance – might change. Furthermore, I was only able to study snapshots of certain states of these cases at one point in time. Therefore, I highly encourage researchers to follow specific blockchain systems over time to distill their governance challenges in more detail and, more importantly, to analyze how they changed and for which reasons. This might uncover governance structures, that remained hidden, and which go beyond what I was able to retrieve from the expert interviews.

Methodological limitations. For this dissertation, I admit several methodological limitations. First and foremost, this dissertation relies mostly on expert interviews conducted with key stakeholders from blockchain projects. While I am confident to have conducted these interview-based studies with necessary rigor - in preparation, execution, and analysis -, I was limited in my insights by the depth of information I could retrieve. Thereby, I interviewed 3-4 interviewees per case. The latter is crucial, as the retrieved answers were subjective to the interviewee's perspective, which might miss critical aspects of governance in their respective projects. On the same note, I strove to mitigate this effect and to increase the validity of my findings by complementing interview data with grey literature about these projects. This was helpful to understand the cases in more depth, but it did not substitute the need for a more comprehensive inside-view of these companies. Furthermore, I admit that the types of blockchain systems selected in this dissertation vary, which does not allow us to make generalizable statements for blockchain governance in general.

Governance in and around blockchain system is one of the most pressing issues in blockchain research. Blockchain systems opened this research gap right from the start by design: while most of the shown governance challenges are addressed – efficiently or not – in hierarchies, markets, or networks, blockchains not only displace these out of formal organizations, but also brings forward new challenges, which must be addressed. This is not to impair the beauty of its prospects, as Bitcoin runs for over a decade, and other types of blockchains continue to evolve, partly with higher funding available than any other crowdfunding or FOSS project has ever seen. Consequently, I am confident that the upcoming years will offer very fruitful ground for empirical research along the theoretical lines shown in this dissertation.

Part I: Exploratory Contextual Research

2 PAPER I: Consensus Through Blockchains: Exploring Blockchain Governance across inter-organizational Systems

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Abstract

The blockchain technology challenges the view on established modes of governance by offering distributed authentication without the need for a central authority, which is well-exemplified by Bitcoin. While the governance of and through Bitcoin is well-accentuated in research, we spotlight impacts on governance which blockchain-based systems bring to inter-organizational settings as well as their purpose. To build our arguments, we explore those impacts on two contrasting cases from the domains of automotive and public administration and relate them to cryptocurrencies. Relying on interviews with experts from said organizations utilizing blockchain technology, and a content analysis of related grey literature, we discuss established forms of governance as well as platforms and infrastructures against the impacts which blockchain-based systems cause. After referring those to the concepts of markets, hierarchies, networks, and tribes, we critically reflect on their purpose by utilizing the notions of infrastructures and platforms, and conclude blockchain-based systems to possibly alter the way established modes of governance are enacted.

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2.1 Introduction

Ruling with many rulers is not easy. Ruling without rulers is a paradox in theory with interesting consequences in practice. Both stances manifest in the emerging problems of governance regarding blockchain-based systems. Bitcoin, born at the time of a major financial crisis and the most prominent blockchain to date, proved at scale the technical functioning of this distributed consensus system. However, it also continues to show the shortcomings of its mode of governance, which refrain from formal and central authorities. The maintenance of the public ledger of all Bitcoin transactions relies on distributed mining, which substitutes external authorities acting as intermediates, often depicted as expensive and prone to corruption. In other words, trust is promised to be maintained by a cheaper system which leaves little space to political maneuvering. This is proving questionable. We explore this and related issues in practice by considering several different implementations of blockchains.

Despite its growth, due to substantive inflow of capital in recent years, Bitcoin's peculiar governance proved troublesome: Bitcoin's decade long history is defined by constant crises (De Filippi & Loveluck, 2016a), particularly in relation to never-ending conflicts on core technical decisions with far-fetched consequences. Those problems put repeatedly Bitcoin on the verge of a stand-still if not collapse (De Filippi & Loveluck, 2016a), and arguably hindered a number of innovations like micro-payments.

Those remarkable set-backs did not hurt the great deal of enthusiasm that persists around blockchains. This can be best exemplified by the so-called decentralized autonomous organizations (DAOs: Self-organized communities whose operation is set in code) as three projects alone (Tezos, Aragon, TheDAO) gathered hundreds of millions USD in funds just to run in governance problems shortly after (DuPont, 2017; Floyd, 2018). Hence, the hype that blockchain solutions come wrapped in may not predict how they will develop in practice but it explains what stakeholders mobilize resources, how they use them, and with what expectations, which is consistent with the concept of the organizing vision proposed by Swanson and Ramiller (1997). Therefore, most of our data collection relied on interviews with key figures in their respective companies. For the time being, we have no way, nor it is our intention with this paper, to enter the prediction game. Rather, we use those cases to distill insights into if and how blockchains impact governance in inter-organizational settings.

This research has an exploratory character and is inspired by the call for a deeper understanding on how blockchain systems can be utilized and what impacts on governance they cause (Beck et al., 2018; Tapscott & Tapscott, 2017). We understand governance as the means for organizational and economic coordination utilizing decision rights, incentives, and accountabilities (Beck et al., 2018); we study and contrast the governance *of* (system governance) and *through* (brought by the system) blockchains.

In sum, the aim of this paper is to contribute to the scarce body of knowledge on governance in and around blockchain-based systems, which targets a vibrant and growing debate in academia and practitioners'. To achieve that purpose, thus improve also the practice of governance in different domains, we reviewed a large amount of grey literature (authoritative and specialized news, blogs, articles), complementary to the scarce scientific literature, and interviewed and analyzed 18 companies to uncover reoccurring patterns of governance. Our effort was led by the following research questions:

RQ1: How do blockchain-based systems impact governance?

RQ2: How does their governance relate in practice to established forms of governance as well as platforms and infrastructures?

To better characterize the systems we studied, thus to answer our research questions, we related our cases to ongoing debates. Most cases that we studied are at early stages, but we see two lines of development emerging: One more profit-oriented, the other more motivated by the pursue of public good. Relying on the dichotomy well-formalized by Plantin et al. (2016), the former is better explained by the concept of platform, the latter by that of infrastructure. It has to be stressed that a platform and infrastructure do not necessarily match specific types of blockchains, respectively: In fact, blockchains like those used in many land registry cases may be oriented to public good, whereas blockchains like Ethereum may aim at two- or multiple-sided markets that are typical of platforms. Last but certainly not least, it has to be stressed that these domains of application remain very fluid. So, applications presenting characteristic of platforms may develop into infrastructures and vice versa. Plantin (et al. 2016) argue that Facebook and Google perform infrastructural functions despite having begun as platforms. Those two concepts, the former more suitable for public services and utilities, the latter more for businesses engaged in the so-called sharing economy, prospect different forms of governance, which may vary depending on the actors involved, main stakeholders, and blockchain's purpose. Some may point to existing governance types, others to novel ones.

The paper is organized as follows: Our literature review connects works on governance with insights from the blockchain domain. After this, our methodological choices are described. For the results section, due to space limitations, we clustered kindred cases and present three of them in detail in respect to their purpose and the way they are governed; findings from the remaining cases are filled in wherever appropriate. The discussion reflects on shown cases, discusses their merits and pitfalls, and sets them in relation to established form of governance. The paper concludes with possible avenues for future research.

2.2 Literature Review

In this section, we introduce fundamental concepts of blockchain technology, differentiate between variations of its current governance, and relate them to existing modes of governance.

2.2.1 Blockchain Classification

We will refrain at this point to provide a detailed technical explanation of how blockchains work as this paper centers on their advantages and shortcomings from a governance perspective. As foundation, however, we rely on Beck et al. (2018) who defines the blockchain as "(...) a decentralized, transactional database technology that facilitates validated, tamper-resistant transactions consistent across a large number of network participants called nodes". According to Peters and Panayi (2015), a classification of blockchain systems can roughly be seen along the access to transactions (public or private) and the right to validate transactions (permissioned or permissionless).

Access to Transactions	Access to Transaction Validation	
	Permissioned	**Permissionless**
Public	All nodes can read and submit transactions. Only authorized nodes can validate transactions.	All nodes can read, submit, and validate transactions.
Private	Only authorized nodes can read, submit, and validate transactions.	

Table 4. Classification on Blockchain Types, taken from Peters and Panayi (2015)

2.2.2 Governance and its many Faces

In an effort to classify forms of governance into archetypes, Williamson (1975) defined the *market* and the *hierarchy* based on transaction costs (Williamson, 1981), i.e. one or the other depend which one has a lower transaction costs for a given purpose. Powell (1990) later extended this classification with the *network*, which differs from both market and hierarchy and which is more efficient in domains in which trust is central and outcomes are difficult to measure. The *bazaar* (Demil & Lecocq, 2006) as well as the *tribal* (Miscione et al., 2018) archetypes are based on digital modes of governance that emerged later. We anticipate them here and explain them below.

The hierarchy refers to the walled-up, bureaucratic, authority-based fashion of organizing and coordinating. Markets, on the other hand, constitute a coordination form in which ownership, price, and trade freedom are fundamental. The network refers to relatively stable inter-organizational relations, where reputation and reciprocity build a maintain trust, which substitute hierarchical power and the invisible hand of market forces. As for the actor's preferences (Powell, 1990; Williamson, 1975a), they can be seen as independent (market), dependent (hierarchy), and interdependent (network). Besides enhancing managerial controlling in hierarchies, IT is also said to impact the inter-organizational forms of coordinating economic activities (networks and markets) as it facilitates the sharing of data and by that lowers costs of agency and coordination. From an agency perspective, IT lowers agency costs in relation to one company's size by providing scalable systems for supervision and coordination (Klein et al., 1978).

Williamson's and Powell's classification does not suffice to capture some of the characteristics which emerged after their writings, especially in relation to information technologies. This can be seen in free and open-source software (FOSS) with the formulation of the bazaar archetype by Demil and Lecocq (2006). FOSS lowers significantly transaction costs through unrestricted access to source code, which prevents the trade of software as property. Actors can wander and choose among products upon liking, with low incentive and control intensity. The identities of parties are partly relevant, as software developers build their reputation. Overall, the bazaar follows the normative basis of openness and fairness. Following Miscione et al. (2018), the bazaar differs from (1) networks as togetherness remains fluid, (2) from markets as no exclusive ownership on a product is granted, and (3) from hierarchies as formal lines of control nor a defined organizational structure can be found.

As for the last archetype, the tribal governance (Miscione et al., 2018) captures peculiarities of governance in the blockchain domain: Blockchains differ from FOSS, thus bazaar, because they bring authentication thus uniqueness of data to digital environments, hence rivalry among actors – e.g., a bitcoin/digital tokens always belong to one entity and no one else at any point in time. This contrasts to digital infrastructures as we have known them today, where replication costs are nearly null, and scarcity a non-issue (Benkler, 2006; Zittrain, 2006). Uniqueness of data (or token in blockchains) gives them value. As soon as there are conflicting versions of data, people lose trust in the reliability of the ledger, so its value decreases or disappears altogether. The same holds true for a community surrounding blockchains: Its users have a mutually dependent interest in the uniqueness and reliability of data and its value, which originates an organizational togetherness that the bazaar archetype does not account for and makes forks undesirable (Miscione et al., 2018). As the ledger acts as the consensus mechanism, the majority can enforce changes to the protocol upon the minority. This fashion of coordination has been labeled "Tribal" as it reflects the togetherness of a tribe but also the openness to join or leave other tribes upon liking (Miscione et al., 2018). Table 5 contrasts the governance types.

Features	Explanation	Market	Hierarchy	Network	Bazaar	*Tribal*
Contract Framework	Legal framework for transaction	Classical contract – Property rights	Employment contract	Neoclassical contract	Open license contract	*Post hoc: A record if/when needed*
Coordination Mechanism	Means of governing exchanges	Price	Formal line of authority	Embedded relations	Product	*Adherence to the technical protocol*
Normative basis	Main regulatory force	Market exchanges	Forbearance	Exchanges	Openness and fairness	*Consensus-based*
Identity of parties	Importance of parties' identities	Irrelevant	Irrelevant	Relevant	Partially relevant	*Pseudonym-based*
Nature of incentives	Incentives for transacting parties	Competition	Status	Reciprocity	Reputation	*Hoarding / Reliability*
Incentives Intensity	Agent's motivation to contribute	High	Low	Intermediate	Low	*High*
Control Intensity	Capacity to enforce regulations	Low	High	Intermediate	Low	*Low (outside) Intermediate (inside)*

Table 5. Governance Archetypes and Features, taken from Miscione et al. (2018)

2.2.3 Public and permissionless Blockchains and their Governance

The best known and widely spread kind of blockchain are permissionless and public ones like Bitcoin, Ethereum, and many, mostly token-based systems, which attracted interest of research (Campbell-Verduyn, 2017; DuPont, 2017; Morabito, 2017a; Reijers et al., 2016; Tapscott & Tapscott, 2017). Those systems, in general, rely on decentralization, immutability, auditability, and anonymity (Quinn DuPont and Bill Maurer, 2015), eliminating the need for a third party such as banks or auditors (Gerald P. Dwyer, 2015). Those systems are open for participations either for transacting or validating. Participants can be relying on a pseudonymous identification through key pairs (public and private), which may not disclose any legal identify. From a user's perspective, transacting on those systems is incentivized by higher transaction speed (minutes instead of days) and lower transaction fees, especially when international payments are concerned. In blockchains based on proof-of-work, which is currently the most common architecture, validation is incentivized by a reward which is randomly allocated to miners, who can increase their chances by providing more hashing power. Incentivizing computing power constitutes a core mechanism to ensure transaction validity and network security, thus its allocation keeps miners honest. This coordination mechanism of the technical protocol defines how validators can participate in the blockchain functioning. Differently from other information systems, developers' influence over its design is counterbalanced by both miners and users' influence (Morabito, 2017a; Walport, 2016).

There is neither an identifiable, thus accountable, nor a steering board for Bitcoin or Ethereum but influential actors such as core developers (Bitcoin Core contributors), opinion leaders (Vitalik Buterin at Ethereum), and mining pools; an eventual agreement of any sorts resides with the variety of actors involved in their respective blockchain. Even though the influence of Bitcoin's core developers and Vitalik Buterin on emerging governance issues varies, the absence of a clear decision-making and accountable authority challenged both blockchains. Eventually, it caused delayed decision-making processes, an attempted centralization of decision power by core developers, and eventually hard forks (De Filippi & Loveluck, 2016a). Public and permissionless blockchains surely constitute an interesting approach to governance, but their evolution and trustworthiness on the long term remains to be seen. Other utilizations of blockchains, such as permissioned, private, or consortia-based implementations constitute more recent novelties and thus demand exploratory research.

2.2.4 Inter-organizational Relations, permissioned Blockchains, and Governance

The prospect of digital scarcity, thus immutability, through native authentication, and the possibility of governance through blockchains is also reflected in the rise of business consortia to explore the benefits of blockchain technology for own profit-seeking behaviors (Gratzke et al., 2017). Collaboration among companies, however, is a challenging endeavor as history has shown (Daugherty et al. 2006; Fawcett et al. 2015). Inter-firm rivalry, own interest, and lack of trust are some of the many inhibitors to inter-organizational collaboration; a governance structure in those settings can be safeguarding each company's interests (Cao and Zhang 2011; Fawcett et al. 2015; Walport, 2016).

Permissioned blockchains vary in assigning transaction, validation, and access rights. While permissioned blockchains preserve some permissionless blockchain's core characteristics such as decentralization, immutability, and auditability, the participating actors, in contrast, are known. Thereby, they strive to foster collaboration between known (hence accountable) parties with agreed upon validators and other enforcing systems to be used to maintain the ledger. Network maintenance, in contrast, is not primarily driven by mining but by other, more efficient consensus algorithms like proof-of-stake. The value of the stored data in the permissioned blockchains still depends on its unambiguity, which fosters the participants' common interests and sense of togetherness. Same as in permissionless blockchains, consensus on permissioned blockchains is defined by the technical protocol; the decision upon the technical protocol, however, relies on the consensus of the parties or consortium which initiate and run the blockchain with some shared interest (it has to be noted that once inscribed in technology and deployed, the functioning is difficult to change). The latter contrasts both blockchain archetypes: Consensus among known parties with shared interests vs. consensus among unknown parties whose interests may vary greatly.

The feature of embedding programming functions on blockchains is appealing as it promises to automatize parts of business processes. Those pieces of software are usually referred to as smart contracts (Gatteschi et al., 2018). Referring to social contract theories, Reijers, O'Brolcháin, and Haynes (2016) concede that smart contracts in blockchains enable to create a self-governing partnership with enforceable rules of interaction without the need for a central authority (Werbach, 2017). Smart contracts thereby contribute to an governance through blockchain (Kitchin, 2017). It is worth mentioning that smart-contracts can be seen as a way to extend the influence of algorithms beyond the governance *of* blockchain to the governance *by* blockchain (Pelizza & Kuhlmann, 2017) to the extend they can help governing domains like, e.g., the second-hand car market (Notheisen et al., 2017). Same as with many other systems, the business logic inherent to a smart contract depends on its environment and is subject to change (Nitto et al., 2008). This requires the collaborating parties that run the system to agree on a minimum common ground, which may vary in inter-organizational collaboration (Daugherty et al., 2006).

2.3 Methodology

Building on what is commonly understood as blockchain governance, we strove to explore how organizations at different levels of advancement in their blockchain efforts approach governance (blockchains in conceptualization, development, or operational), what purposes they serve, and – as much as possible – how they put them in practice. As typical for exploratory research (Briggs & Schwabe, 2011; Stebbins, 2001), we utilized all available sources and derived appropriate concepts to describe them. Overall, we followed those steps: A literature review, semi-structured expert interviews, review of grey literature, data analysis, and evaluation and refinement, which are detailed in the following.

First, we conducted a literature review, which covered the relatively scarce body of academic publications available to date following the methodology proposed by vom Brocke et al. (2009). We retrieved those publications from searches on the main online databases (including Scopus, Web-of-Science, Google Scholar, iEEE), using a variety of search terms about blockchain governance and used both forward and backward searches. Then, the same approach has been utilized to cast a typology about shared systems and how organizations strove to collaborate using shared systems in the past, e.g. in the supply chain domain (Stevens and Johnson 2016). This allowed to put permissioned blockchains in a broader academic context. This depicted the state of the art and further enabled us to define our interview questions.

Interview	Case No.	Domain	Location	Maturity	Role
1	1	Land Registry	Ghana	Proof-of-Concept	CEO
2	2	Land Registry	Honduras	Proof-of-Concept	Project Manager
3	3	Supply Chain	USA	Operational	IT Employee
4	4	Cryptocurrency	Globally	Operational	Team Coach
5	5	Land Registry	Estonia/Sweden	Completed Proof-of-Concept	Project Lead
6	6	Cryptocurrency	Globally	Operational	Project Lead
7	7	Supply chain	Switzerland	Conceptual	Board Member
8	8	Cryptocurrency	Globally	Conceptual	Project Lead
9	9	Supply chain	China	Conceptual	CEO and Founder
10	10	IPR	Globally	Completed Proof-of-Concept	Associate Director
11	11	Supply chain	Belgium	Completed Proof-of-Concept	Co-founder and CPO
12	10	IPR	Globally	Conceptual	Application Engineer
13	12	Cryptocurrency	Switzerland	Operational	IT Director
14	11	Supply Chain	Belgium	Completed Proof-of-Concept	Business Developer
15	13	IPR	Globally	Operational	Application Director
16	14	Land Registry	Georgia	PoC	Security Managers
17	14	Land Registry	Georgia	Conceptual	Project Manager
18	15	Cryptocurrency	Switzerland	Completed Proof-of-Concept	CEO

Table 6. Overview on Interviewees and Cases, adapted from Ziolkowski et al. (2019)

Second, as for the empirical part, since 2017 we searched for as many actual blockchain systems as possible on a variety of online sources like Crunchbase and Coindesk. Identifying cases of operational blockchains, however, proved a difficult task. While there is a plethora of blockchain startups, GitHub projects, and similar in the initiating phase, advanced blockchain-based systems are hard to find. As a result, scientific research with solid empirical grounding appears still scarce. From a longlist of 121 companies, we chose those we deemed most mature and appropriate based on company size, collaborators, time length of operation, and revenue, if available, which resulted in 42 companies whose representatives we invited for expert interviews. Those have mostly been held via phone or conference calls with an average duration of one hour in the fashion of semi-structured interviews, following the classification by Myers and Newman (2007), in respect to the exploratory character of our research, leaving room to lean towards interviewee's perspective and to foster discussions. To assure the right framing and the appropriate person to speak to, we introduced our research in brief and sent exemplary questions beforehand. 18 representatives from 15 different companies responded to our call. Our interview sample thereby covers blockchain experts from higher management from various parts of the world, and a variety of application domains as it can be seen in table 6. The interviews were then transcribed as a preparation for coding.

Next, we complemented the interview data with additional information, mainly from grey literature (whitepapers, widely considered authoritative specialized blogs and news-site, practitioner's reports, company websites), on respective companies to enhance the internal validity of our findings through triangulation of different data sources. As for the analysis, we coded all information and discussed the results among ourselves. Our coding dimensions centered around governance and system characteristics: (1) The purpose (aspired business case/fit of blockchain), placement of (2) accountabilities, (3) incentives, and (4) decisions and their enactment, (5) related actors and their relationships, (6) challenges (technology- or organization-related), and (7) system design. As all researchers involved in the coding process were familiar with related concepts, a training for coding was not deemed necessary. The triangulation of data caused rare disagreements among coders; where necessary, deviating codings were resolved through discussion on the basis of available information. For external feedback, we made the coding results available to other research groups and revised them in accordance to their feedback where necessary.

Our coding has shown certain patterns about the way governance is practiced. Rather than presenting all cases in detail in the results section, we highlight three cases, each standing for several kindred cases. For a first conceptualization system-wise, we compared our codes with the features that Plantin et al. (2016) proposed. Later, we considered our results to the governance archetypes (Demil & Lecocq, 2006; Miscione et al., 2018; Powell, 1990; Williamson, 1975a). The coding's results are shown in tables 7-12 below.

2.4 Results

Our interviews focused on how blockchain systems impact governance in their respective domains. The following three cases, which represent groups of kindred cases, illustrate these impacts. We introduce each case in brief and explain its underlying governance system. In a next step, we relate our findings to Plantin et al.'s (2016) items for classifying the cases into platforms or infrastructures.

2.4.1 Blockchain-based Land Registries

The land registry domain gained attention in the last years as a promising use case for blockchain systems as they may overcome several of the challenges of this complex and multi-stakeholder (land-owners, brokers, notaries, banks, and state agencies) inter-organizational setting with far-fetched ramifications in all parts of economy and society. The processes of authenticating rightful land ownership and the rightfulness of a land ownership transfer vary vastly among countries; overall, they can be considered slow, sparsely digitized, often opaque, and costly. Because of its high valuations at stake, not least for its use as collateral, land registration is heavily exposed to fraudulent behaviors which have been particularly problematic in developing countries (De', 2005, 2006). From a cost perspective, notaries would charge up to 4% of the property's value for granting a state certificate; in EastLand (anonymized), e.g., the land registry application fees range between 50-200 USD (against a GDP per capita in 2016 of USD 4,000 ca.) depending on the speed of the transaction to be notarized. Especially in developing countries, those high costs contribute to a high percentage of land left unregistered, up to approximately 78% in Ghana (Kshetri, 2017). Furthermore, most of those records are paper-based. A blockchain system promises to increase the efficiency cost- and time-wise dramatically; the same could hold true for the transparency and reliability of records. On a blockchain, both costs could be reduced to no more than 0.05-0.10 USD per transaction (Kshetri, 2017). From a temporal perspective, the processes of land registration or transfer might be conducted within days instead of months. Last but not least, transparency and immutability of the ledger may reduce corruption. The following case of EastLand (anonymized, case in eastern Europe) depicts its properties further; in its core, its kindred with three more cases we analyzed.

2.4.2 The blockchain-based Land Registry in eastern Europe and its Governance

EastLand is a well-known country for its advancements in digitizing public services. Since banks, notaries, and EastLand's agency of land registry (ALR) are loosely coupled and cannot trace processes amongst each other, mistakes occur and they are costly to correct, also for citizens. Hence, EastLand's ALR started in 2016 a project together with a platform developer for a blockchain-based land registry. Their goals have been to digitize and facilitate transacting in registering and transferring land ownership. In a first effort, the paper-based records of land ownership have been digitized and imported into a private and permissioned blockchain. Relying on the digital version of all records, the platform developer implemented a set of smart contracts for the process of buying and selling land which aim to replace the previously manually conducted authentication processes. Those measures do not only promise to decrease transaction costs in land registry or transfer by avoiding costs associated with hiring and interfering with legal authorities but are also said to increase the reliability of records.

This motif has been confirmed by other stakeholders in land registry projects in northern Europe, middle America, and Northern Africa, who we interviewed.

The governance of EastLand's land registry function is organized in collaboration of several parties and the ALR. Although their blockchain system is technically consensus-based, the ALR is leading the effort while holding major decision rights, inter alia on system design, data authenticity, and access control. As the lone gatekeeper to the system, the ALR effectively steers the in- and outflow of participating actors. The ALR further can exclude unwanted actors or reverse fraudulent transactions, which overcomes blockchain's decentralization dogma. Indeed, the ALR is imposing its decisions onto others what is remarkable for blockchain systems which are rooted in the rejection of authorities. We could observe a similar governance approach in the other land registry cases we considered. As major decision rights are centralized at the ALR's, its governance might point towards a hierarchy, in which transacting agents follow a formal line of authority with bureaucratic procedures, which are partly automatized.

The main issue, which too often is conflated with immutability, is how to certify data quality before it gets on the immutable ledger. In Eastland, the ALR is responsible for data entry to the system, which requires trust in its reliability. For the sake of transparency, the ALR foresees two measures: firstly, it allows parties to access the ledger, which contains all historical data, and thereby to control the well-functioning of the system (banks, notaries, and later also citizens). Secondly, its own blockchain is concatenated with another one to implement a backup function: The state of the ledger is backed up to the Bitcoin blockchain in form of a hash at specified points in time. This serves as a checkpoint and prevents fraudulent behavior on past transactions; the immutable Bitcoin blockchain thereby assures a given state of the land registry ledger at a given time. Interestingly enough, this may open up a novel legal dimension as it may decouple claims on land ownership from its local jurisdiction. This may prove helpful when records are in doubt, local authorities would not help, EastLand's system fails to work, or, in extreme cases, when states are overtaken.

In sum, EastLand's case shows an example of how a blockchain-based system impacts the land registry function and its governance (see table 7). Creating a distributed system within an existing eco-system while preserving some centralized decision-making locus may prove a promising solution to (1) share the audit of the system for accountability, (2) foster inter-organizational business process integration (hence, efficiency gains), and (3) increase the reliability of records (trust in the overall system).

Feature	Description
Governance	Governed in a hierarchical fashion
Actors	Platform provider, the agency of land registry of EastLand (ALR), Representatives of civil society, banks
Domain	Public Administration
Purpose	Digitizing land registry records and facilitating transfer of land ownership; part of a major government digitization initiative (similar to the cases of Northern Africa, Northern Europe, and Middle East)
Prior Governance	Point-to-point, distributed coordination of actors with state being in charge; notaries, banks, and state share responsibility but act independent; manual authentication; non-transparent and tedious processes
Impact on Governance	Actors tightly coupled; State has technological leadership while allowing banks, notaries, and citizens to audit its operation; a set of smart contracts govern land and fund exchange; besides digitization, lower transaction and agency costs (transparency); data integrity ensured through multiple blockchains

Table 7. Governance in a blockchain-based Land Registry

2.4.3 Towards a public blockchain-based Infrastructure

Following the classification of Plantin et al. (2016), the current implementation covers many of the characteristics of an infrastructure which is in line with the other cases we collected data about (see table 8). From an architectural standpoint, the ALR, together with the platform developer, runs the only validating node – the control over the system is, hence, centralized under state authority. Other parties, such as central or commercial banks, and representatives of civil society, however, run auditing nodes, which allows them to double-check occurring transactions for validity and their compliance with law. The property transactions are not public for citizens to see them, yet. On the long run, reading access for citizens will be granted – transaction details, however, will remain private. The overall system is heterogeneous and connects the blockchain system with systems of other digitization initiatives (e.g., electronic personal ID linked to the land registry system) and, hence, can be considered as tightly integrated; their interoperability is thereby assured through standards set by the ALR. The system is further regulated exclusively in public interests with its focus on public value, as a land registry acts as an essential service of property ownership. Standards are de jure (at the moment) and dictated by the ALR.

The blockchain-based land registry is designed with scalability and longevity in mind, hence long-term reliability and availability of data. Thereby, the blockchain-based system should be able to scale to cover all country's land, so to cover all land titles, ideally. For the time being however, this scale is not yet reached. As for the agency, users would be locked in the system because a competing system would put data integrity in doubt (scarcity of data); a fork of the same blockchain would theoretically be possible – in practice, the previously described link to the Bitcoin blockchain would make forks ineffective as the authentic ledger always can be identified. A further anchor for data authenticity, which applies solely to the case of EastLand, comes from the known identities of actors through a digital personal ID for citizens; transactions can therefore be allocated to legal persons. The latter is of particular importance as this allows for an accountability of actions, which can be used in courts in case of disputes.

Feature	Description
Architecture	Heterogeneous systems connected via gateways; interwoven with other infrastructures; embedded in the overall architecture of government digitization initiatives (e.g. national ID per citizen); ALR as system gatekeeper with the only validating node; Banks and other interested parties may become auditing nodes; centralization of authority at the state's (similar to other land registry cases)
Interoperability	Interoperability will be assured through standards; tightly integrated
Focal interest	Public value; essential service. Empowering citizens to conduct necessities regardless their geographic location
Standards	De jure; set by state agencies (as the ALR)
Temporality	Long-term; reliability is crucial for data integrity
Scale	Large to very large, country-based
Funding	Government
Agency of users	Theoretically locked-in; one source of truth regarding land registry entries. Practically, forks are possible

Table 8. Land Registry Description, Features taken from Plantin et al. (2016)

2.4.4 Car Data and blockchain-based Systems

The information asymmetry constitutes an integral part of markets and causes the parties with better information to strike better deals Akerlof (1970). In the following, we shed light on the promising solution which currently is in progress and which promises to solve some of those challenges. The automotive sector is a promising domain for blockchain-based systems. In the past years, many initiatives have been launched to digitize the eco-system around the car. Those initiatives range from B2B platforms for authenticating spare parts to the aggregation of a car's related data itself for information transparency. The latter relates to *Market for Lemons* by the Nobel Laurate Akerlof (1970), which regards the information asymmetry in the used-car market – bad cars are said to supersede good ones to their extinction. Tracing car's lifecycle, aggregating its data, hence, aims at reducing the information asymmetry between buyer and seller by making data immutable and accessible to different parties in the same eco-system.

2.4.5 The blockchain-based CarDossier and its Governance

During a lifecycle of a car, numerous stakeholders (insurances, repair shops, state agencies, and many more) are involved. These conduct authentication processes manifold (such as proof of car ownership, insurance/driver's license validity) while collaborating merely to the necessary degree; this leaves all information of a car fragmented at best which entices to opportunistic behavior. The CarDossier, a Swiss-based project initiated in early 2017, strives to overcome these challenges. For the time being it consists of a consortium of major stakeholders in the Swiss car ecosystem such as the biggest importer and repair shop of cars, a major insurance, a road traffic agency, legal experts, a mobility service provider, as well as a research and an IT implementation partner. Building a blockchain-based system to gather, maintain, and access car-related data benefits businesses, citizens, and state agencies as it constitutes a promising approach to reduce the information asymmetry of car-related data and to achieve operational excellence amongst each other. To make the system work, not only car drivers but also corporations and state agencies contribute car-related data (e.g., telemetric, accident history, changes to the car) which in turn may be accessed and processed by others for financial compensation. The CarDossier entitles the car-owner to decide upon his/her data, which differs from corporations using data for their own profit.

The CarDossier includes an organizational core which consists of a board of representatives of major stakeholder in the car ecosystem; all major decision rights are centralized at the board's level. Their demands are translated into system requirements and then developed and enacted by a third-party platform provider. The collaborating partner's interests are not the same but partly overlap. It is therefore of highest importance to safeguard each partner's interest to maintain their willingness to collaborate. The CarDossier project, hence, ensures all major stakeholder's voice to be heard in regular board meetings. The decision-making process, however, is split in two: Members are allowed to propose changes to the system, similar to the DAO. While lower-critical changes can be decided, budgeted, developed (by the third-party platform developer), and enacted autonomously upon vote by its members, strategic decisions remain decided upon vote at the board to ensure the project's right course.

The overview allowed by blockchain data offers an audit trail that guarantees the data about a car has not been tempered with. As in the case of EastLand, rightfulness depends on data quality, not immutability. If wrong data is entered, it remains wrong on the blockchain. What is worth stressing instead is that immutability is a good deterrent of fraud, because wrong data stays wrong and can be brought to court.

What's more, the system collects personal and car-related data. While the sharing of the latter is rather harmless, the former is quite sensitive, and drawing the line between the two may not be straightforward. To be legally compliant, the system has to be designed compartmentalizing different kinds of data. The CarDossier not only provides a single source for car data, but also immutable, shared, and agreed upon functions, e.g. the rules for data access management (via encryption/decryption). These rules are inscribed in smart contracts and vary per role (a role represents an actor in the ecosystem); a role merely sees data which s/he is allowed to see. A role can further inhere rights to perform specific functions, such as issuing an electronic vehicle registration document (road traffic agency) or the insurance certificate (insurer).

At its very core, the CarDossier inheres the same architectural design and governance as four more companies we interviewed and analyzed; in those cases, know-your-object (KYO) was targeted, meaning the tracking of a good throughout its supply chain and making this information visible to supply chain participants for one and to end customers for two. Those systems offer a means for prior loosely integrated entities to connect and collaborate through a shared repository of formerly isolated or not available data.

In sum, the CarDossier relies on the strengths of blockchain-based systems in inter-organizational settings shown in EastLand in terms of (1) shared audit of data for accountability, (2) efficiency gains through process integration, and (3) an enhanced reliability of records. Following the classification by Powell, the envisioned blockchain-based implementation may fit well to the network archetype. The CarDossier is further described in table 9 below.

Feature	Description
Governance	(Business) Network
Actors	Major stakeholder in the Swiss car ecosystem: An insurance, importer and repair shop, mobility provider, road traffic agency, legal experts, an IT consultancy
Domain	Automotive
Purpose	Digitizing front- and backend processes, public and private. Enhancing trust in the used-car market with holistic and historic data. Bringing data ownership to data owners.
Prior Governance	This is a novel collaboration, comparable collaboration characteristics: Conventional business collaboration; contractual means (manual definition and enforcement); consensus by meetings
Impacts on Governance	Possibility of proposing advancements of the system (and its automatized enactment upon agreement); Division into autonomous/strategic decisions; welcoming end-users to participate in decision-making processes; Data Access Management / Transaction permissions governed via smart contracts; clear audit trail through (authentic) transactional data – lower agency costs

Table 9. Governance in the blockchain-based CarDossier

2.4.6 Between a Platform for Data Exchange and an Infrastructure for public Use

Relating to the classification of Plantin et al. (2016), does the CarDossier constitute a platform or an infrastructure? Defining the CarDossier's system characteristics is challenging. From an architectural point of view, the CarDossier provides a stable core system (the ledger) which will be complemented with variable components in the hands of other companies – an insurance, e.g., could wish to extract data from the ledger for own analytical purposes by using the CarDossier's API. The latter would point towards a platform characteristic. The CarDossier, however, also assures interoperability through standards which constitutes an infrastructure characteristic. The focal interest, however, lies between public value, private profit, and user benefits. The latter also have a say in the CarDossier's design as they can make proposals which are voted upon. The intended timeframe, points at the infrastructure perspective because of its expected long-term life-cycle, with special regard on reliability with a large to very large scale. The system is funded via pay-per-use, which reflects a private cost-recovery mode. One could argue, however, that the CarDossier would provide an essential service for the domain, if embedded right, on a large scale with a public interest, which would point towards an infrastructure. In the foreseeable future, the CarDossier will be enacted as a platform; depending on the extent of public value, use, and interoperability, however, it may undergo the process of infrastructuralization (Plantin et al., 2016). Table 10 below summarizes its characteristics.

Feature	Description
Architecture	Stable core system; modular, variable complementary components; Provision of an API and basic CarDossier Frontend; Loosely integrated with other systems on partner's side; one validating node per stakeholder; peers can be set accordingly. Data access management based on encryption and decryption.
Interoperability	Interoperability will be assured through standards; loosely integrated systems
Focal interest	Primarily user benefits as it targets the purchase of a used-car. Private profit in form of service optimization through analytics and public value through trust in used-car market
Standards	De facto; made in consensus and set by the consortium
Temporality	Long-term; reliability is crucial for data integrity. Updating due to novel types of data cannot be excluded
Scale	Small to very large, country-based
Funding	Pay-per-use, platform character
Agency of users	Theoretically locked-in; one source of truth regarding car data. Practically, forks are possible

Table 10. CarDossier Case Description, Features taken from Plantin et al. (2016)

2.4.7 Blockchain-based Money Management

The public service of money management, has been challenged by Bitcoin and the plethora of cryptocurrencies that sprung recently. According to common-wisdom of this industry, parties like banks and state agencies are needed to ensure the integrity and well-functioning of the financial system. In this multi-tiered system, the authentication of a transaction lies in the hand of established organizations, and customers have no alternatives but relying on those intermediaries to act honestly, and not to exploit the status quo to their only advantage. In general, this system has proven to work, even if costs, especially for international money transfers, remain high. The financial crisis, however, has shown that current financial services can fail. This acted as a catalyst for alternative currencies to rise. In Bitcoin, the authentication of a transaction is conducted on a technical level by 51% of computing power, thus omitting the reliance on any external third party. The eco-system around Bitcoin and the likes consists of actors such as miners, developers, exchanges, wallet providers, and users (wallet holders). Users are allowed to propose Bitcoin improvement proposals (BIP) which are discussed in a public forum, then assessed by core developers and applied if a majority consensus is met. The integrity of the ledger, however, lies in the hand of the miners which are financially incentivized to mine through the same tokens they mine. The mining rewards constitutes a major governance mechanism as it steers the community's behavior.

2.4.8 The Governance of Cryptocurrencies

One may expect that currencies, being the usual counterpart of trades, are defined by market governance. Indeed, this idea is not new. A century ago Hayek proposed to get away from state/fiat currencies and let private currencies to coexist and compete. His proposal didn't uproot state money, which still counts for nearly all world trades. While the emergence of cryptocurrencies revamped Hayek's ideas, the principles of market do not appear to define crypto. Rather, the systems of cryptocurrencies (table 11), whose governance was labeled Tribal (Miscione et al., 2018), is based on consensus, coordinated by a technical protocol, they rely on pseudonymous identities and incentivize hoarding (because of their deflationary nature). Reliability granted by large mining pools, is paired with low control intensity from the outside and intermediate from the inside. The mining reward, constitutes an important governance mechanism as increasing or lowering mining rewards would influence the miners' willingness to mine and, hence, influence the systems security.

Other cases (4, 6, 8, 12, and 15) we considered showed commonalities, but also differences. One of those considers a company in Africa working with their own fork of Bitcoin. Their intention to fork lays in being independent from Bitcoin's decision-making and security risks it may entail (e.g., mining pool centralization). Another relevant case is based in Germany, and it is also about a Bitcoin fork; they forked to add more functionalities to its payment system. The latter and the former cases, and forks of Bitcoin in general, show cryptocurrencies to be easily adaptable to community's needs, which links to Hayek's thought of them not being mere market participants but rather what has been labeled Tribal.

Feature	Description
Governance	Tribal
Actors	Developers, Bitcoin foundation, miners, exchange platforms, wallet providers, (master) nodes
Domain	Cryptocurrency
Purpose	Peer to peer fund transfer; Faster, cheaper, and more reliable fund transfer; alternative to conventional transaction systems; self-determination
Prior Governance	State-backed network, distributed coordination of actors with state being in charge (formally); banks, and state share responsibility but act independent; manual authentication; costly
Impacts on Governance	Distributed system, distributed decision-making authority; BIP steer development; no one (formally) accountable/responsible (unknown actors); actor coordination through protocol

Table 11. Governance of Cryptocurrencies

2.4.9 Towards a public blockchain-based Infrastructure

From a technical perspective, Bitcoin and the other cryptocurrencies fit to the infrastructure type. As for the architecture, they consist of heterogeneous systems and networks running the same protocol. Furthermore, they are interoperable through defined technical standards. Standards are set de facto and the temporality is long-term where system reliability is crucial due to its essential character relating to public good; updating, however, will be done when necessary. Its scale ranges from large to very large and may become ubiquitous if any of these currencies becomes embedded into everyone's daily life. Its funding is achieved through coins for mining and pay-per-use (transaction fees). While theoretically, communities could choose to fork towards an own system, those networks rely on a critical mass to maintain the systems. Since Bitcoin is the first of its kind and obtained the largest scale since then, one could argue the Bitcoin network to be the first proven blockchain-based public infrastructure. Table 12 sums up their features.

Feature	Description
Architecture	Large pool of heterogeneous systems executing a mining protocol in the backend; interwoven with other infrastructures; Open for access (links to the Bitcoin blockchain are found in many other use cases as backups) and transparent in transaction history; Bitcoin Improvement Proposals (BIP) can be submitted by anyone, implemented by core developers if strong majority agreed upon; Proof-of-Work
Interoperability	Interoperability of those systems is assured; loosely integrated; easily replaceable
Focal interest	Public / Community interests; essential service by providing safer, faster, and cheaper payment
Standards	De facto; set through consensus by the community and implemented by developers
Temporality	Long-term; reliability is crucial for data and transaction integrity
Scale	Large to very large, ubiquitous
Funding	Pay-per-use (Bitcoin transaction fee)
Agency of users	Theoretically locked-in; one source of truth regarding transaction and historical data integrity; Practically, forks are possible.

Table 12. Cryptocurrency Description, Features taken from Plantin et al. (2016)

2.5 Discussion

In this research, we relied on three main cases, each of them represents a group of kindred cases, to shed some new light on the emerging phenomena of blockchain governance. In pursuing this objective, we were guided by two research questions:

RQ1: How do blockchain-based systems impact governance?

RQ2: How does their governance relate in practice to established forms of governance as well as platforms and infrastructures?

We start with the answer to the former, then continue with the latter.

2.5.1 Blockchain-based Systems and their Impact on Governance

Each of the analyzed cases' governance is well-characterized by aforementioned governance archetypes: In the form of established ones seen on a hierarchy (Land Registry) and a network (CarDossier), but also in rather emergent ones seen on a tribe (cryptocurrencies). In general, we see that blockchain systems impact governance in practice; these differences may signal broader relevance for archetypes, but this discussion is beyond the scope of this paper. To proof our points, we summarize in the following our findings from the case analyses which characterize governance but also show their shortcomings and set them in relation to existing scientific works.

Sharing the audit for accountability. Interestingly enough, and counterintuitively for blockchains, the blockchain-based land registry gains its legitimation from a single party, who remains in charge of major decisions. The latter is pivotal as land titles constitute high values at stake. While this centralization of power overcomes blockchain's promise of decentralization, the ALR offers full transparency of its records and operations by inviting other parties to audit; this thought is native to blockchain systems and in line with the CarDossier and Bitcoin. However, in the case of northern Africa and EastLand, an additional link to the Bitcoin blockchain further certificates the integrity of past records at a given point in time. Both the concatenation of blockchains and a shared audit creates a multi-tier security architecture which allows to reconstruct records even if single points of the system fail; this approach is especially appealing for developing countries where social order and state powers are often volatile. While this constitutes a promising mechanism to overcome the unwanted tampering of records, the system becomes dependent on the well-functioning of Bitcoin, whose longevity remains to be seen.

Efficiency gains. The re-organization and the efficiency gains can most evidently be seen in the CarDossier project. The extensive utilization of smart contracts to embed business logic to provide automatized financial compensation, data access management, and transaction permissions facilitates the interaction of users with the system and promises to improve the governance of the used-car market *through* a blockchain (Miscione et al., 2018; Pelizza & Kuhlmann, 2017); blockchain systems thereby allow for a more granular planning of governance functions (as they are written in code) and to enact them automatically when defined criteria are met (similar to DAOs). As above, the expectation is, hence, to lower transaction and agency costs (Klein et al., 1978).

In the intentions of the blockchain-based systems in the land registry domain, our findings show that all those and related functions remain enacted in the fashion of a hierarchy led by the state; actors in the land registry ecosystem (the state, banks, notaries, and citizens), however, now partake in a distributed system that guarantees the immutability of transactions, which promises to lower not just transaction but also agency costs. In practice, a set of smart contracts ensures the exchange of funds and land titles. This enacts the notion of governance *through* blockchain (Pelizza & Kuhlmann, 2017) and fosters a novel way of making and enforcing contracts (Reijers et al., 2016). Said efficiency gains show how a blockchain-based system can act as a catalyst for digitization in the public administration while empowering citizens to conduct their business in a faster and more efficient way.

The togetherness of parties inherent to a KYO-case such as the CarDossier project is of different nature than in the case of EastLand as it concerns a more dispersed and flatter inter-organizational collaboration. The CarDossier consortium represents various stakeholders with various interests but at least some sort of common interest to collaborate; hence, we classified this mode of governance 'network'. While the blockchain-based system can be ensured as far as possible to function in the intended fashion, it can be questioned, if it can overcome inhibitors to inter-organizational collaboration (Cao and Zhang 2011; Fawcett et al. 2015). While low trust and poor data quality certainly can be improved upon, inhibitors such as inter-firm rivalry or own interests may persist. Unlike in the hierarchy, where trust in the system can be instilled or enforced from the top, this multi-party network needs to build mutual trust to operate. The trust into the system and its outputs has to be produced (Werbach, 2017); instead of authenticating a single, peer-to-peer transaction, a governing body may be needed to ensure the authenticity and the well-functioning of the blockchain-based system. For the organization behind it, the CarDossier project strives to instill a democratic character through regular consortia meetings to make voices heard – the project, shows an interesting dilemma which may be inherent to many consortia-based collaboration endeavors: Mutual dependence (to aggregate data) and own interest (not to share data).

Data immutability as a deterrent of fraud. While the technical consensus of blockchain-based systems solves the Byzantine General's problem on a temporal dimension, the message he wants to share with his generals remains a challenge: The input to blockchain-based systems is crucial. As soon as an entry has been made, it is irreversible, at least in theory. What entry has been made remains in the hands of the users or authorities; if a land title is wrongfully assigned to someone, this wrong statement would be maintained by the blockchain (and immutable). It can therefore be questioned if a blockchain-based land registry would solve problems, especially in developing countries, where corruption or a certain mistrust into the political order and its operation is widespread. In consortia-based blockchains as the CarDossier, where more complex data is dealt with, authenticating the truthfulness of data entries constitutes a challenging task. Even though one may assign several parties with the same information to cross-validate its truthfulness – at larger scale, this may become a daunting endeavor. The full potential of a blockchain-based system seems to be dependent on actors' honesty. It can be argued then that network and tribal governance risk to fall back to some sort of hierarchy with a high (and expensive) control intensity which would question the necessity for a blockchain-based system. However, immutability can be a good deterrent of fraud: Wrong data stays wrong and can be brought to court, which might steer participants behavior towards acting honestly.

System evolution. While smart contracts seem promising, one should keep an eye on risks (DuPont, 2017), especially when automatisms are expected to generally avoid human supervision. Analogous to the case of EastLand, the CarDossier project develops its platform under the technical lead of an IT provider. The utilization of smart contracts and the design of the overall platform, hence, come with same limitations of possible misdesign because of misunderstanding or changing socio-technical environments (Morabito, 2017a); remaining aware that the environment of an IT system changes over time (Nitto et al., 2008), smart contracts eventually require updating. This increases the risk of incompatible contracts and misalignment between requirements and design. The latter also opens the door for ad-hoc decision-making in case of malfunctions and 'precedents', a crucial issue, especially in countries with Common Law (as opposed to Civil Law). So, in case of disputes, the last resort in all land registry cases we analyzed remain courts. We are not aware of any blockchain-based record that has undergone a trial. It would be of great theoretical and practical relevance to follow such process and see the outcome. Indeed, our findings in land registries and the CarDossier support the claim that intended automatic as well as human decision-making often takes place side-by-side, sometimes distinct and sometimes in competition. Rather than substituting, automatisms are therefore merging with other modes of governance.

2.5.2 Blockchain-based Systems between Platforms and Infrastructures

This part focuses on the relationship between our case-studies and their relationship to platforms and infrastructures. Our results show that several similarities as well as differences can be seen, e.g. in the cases of land registries or cryptocurrencies. Even though blockchain-based applications did not prove themselves at scale, yet (except for Bitcoin and a few others) the interest in using blockchain technology for public services is remarkable. The problem of scale cannot be overemphasized; the Internet, in its beginning, also has been thought of having a very narrow set of use cases to be applied for. Then it became the infrastructure we know today (analogies between blockchains being the new internet have been made repeatedly). The interest in those use cases is due to the native authentication that blockchain system provides: State agencies not only spend a significant amount of effort into authenticating documents between parties and giving public deed, they also put their credibility and legitimation in those. Blockchain systems provide this function natively as long as rightful data is entered. As argued in the results section, land registries aspire to become public infrastructures handled in a quasi-hierarchical fashion. So, a blockchain-based system would ease the ways hierarchies can steer related actors through a shared audit and clearer accountabilities. Bitcoin might be another infrastructure; this hypothesis is backed by a high fit of infrastructural criteria such as reliability, ubiquity, and interconnectedness. The architecture of such systems as Bitcoin or a public infrastructure, however, is in high dependency on other infrastructures (network systems, protocols, and further) which are out of their control; a mere blockchain system would raise doubt regarding its reliability in an extreme situation such as a power outage, or foreign invasion. As public records are of paramount interest, those systems have to provide multiple levels of assurance. The case of EastLand and Northern Africa show their architecture to be interwoven with other (public) trans-jurisdictional blockchains where a backup in form of a hash is sent to in a regular timeframe. Northern Europe, for another, runs its blockchain system next to the regular land registry system for backup.

Besides infrastructures, we also identified cases to mostly fit to the characteristics put forward by platform studies (Plantin et al., 2016). The CarDossier inherits platform features such as programmability and the connection of heterogeneous actors. Being initiated with a conventional platform in mind, the CarDossier may become both platform and infrastructure, in a sort of freemium arrangement: An infrastructure for public use for process optimization and a platform for exchanges by heterogeneous actors; this, however, depends on the extent to which public services and use would be enacted. By this, however, the CarDossier's API remains in the platform's, which centralizes decision rights on the initiators' and maintainers'. So, the CarDossier platform enables a blockchain-based multi-sided market (especially sellers, buyers, companies) and is governed in a network fashion; untypical for platforms, it is thereby not led by a single organization but by a consortium establishing and maintaining it.

2.6 Conclusion

This paper analyzes the governance *of* (system governance) and *through* (brought by the system) blockchain-based systems and argues they impact the way governance can be enacted. We have shown (1) how blockchain-based systems can act as catalysts for digitization and efficiency gains (Land Registry), (2) how they provide efficiency gains in inter-organizational collaboration by automatizing business logic (CarDossier), and (3) how they can provide governance without a de facto steering body (Cryptocurrencies). We contrasted those impacts to common modes of governance to answer the question if and how they would be impacted. We further critically reflected on the use of smart contracts for incorporating business logic and problems it may bring as well as collaboration problems a blockchain-based system may not solve. Those insights may guide practitioner's work. We further related our cases to the notions of platforms and infrastructures and argue Bitcoin already to be an infrastructure embedded in our daily lives; platforms such as the CarDossier, which will remain a platform in the foreseeable future, may eventually become infrastructures by providing essential services with public value at scale.

Same as for every research, our research comes with limitations. First and foremost, governance is best seen when enacted and finding operational blockchain solutions is challenging. Hence, we relied on the most mature cases we could find; enhancing our outreach with further cases would certainly improve the validity of our findings for one. For two, as our research covers four application domains, considering further application domains could reveal further blockchain impacts on governance our sample does not account for. Further, academic discourse on blockchain governance is ongoing; hence, we strove to utilize well-known works from adjacent domains as complementary sources to improve the understanding on blockchain governance in practice.

Influenced by this research, several future research avenues may arise. As for cryptocurrencies, this research, among others, points at the gap between the open and distributed governance Bitcoin envisions and problems in its design. Seeing a means of payment as an infrastructure embedded into our daily lives, and the imperative availability it entails, the development of a sustainable governance will be pivotal for it to prevail and has yet to be found. In a similar vein, it remains of interest to explore how blockchain technology will be utilized and governed in inter-organizational settings on the long-term. Governance issues manifest themselves in practice. Hence, comparing a project's aspired governance to the way it develops when operational promises detail about misconceptions. It further remains an open question, how data quality in terms of input and preservation can be ensured, especially when state participation is considered, and if efficiency gains can be realized or if those are deprived by additional cost of supervision. Finally, it remains of highest interest to compare different blockchain systems referring to the same governance archetype to ground blockchain's impacts on those in more evidence. While we have seen in our research blockchains to allow for novel ways of enacting certain governance functions, it remains to be seen, if the archetype typology requires reconsideration.

3 PAPER II: Decision Problems in Blockchain Governance: Old Wine in New Bottles or Walking in Someone Else's Shoes?

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Abstract

Blockchain technology comes with the promise of being a disruptive technology with the potential for novel ways of interaction in a wide range of applications. Following broader application, scholarly interest in the technology is growing, though an extensive analysis of blockchain applications from a governance perspective is lacking to date. This research pays special attention to the governance of blockchain systems and illustrates decision problems in 14 blockchain systems from four application domains. Based on academic literature, semi-structured interviews with representatives from those organizations, and content analysis of grey literature, common problems in blockchain governance have been singled out and contextualized. Studying their enactment revealed their relevance to major organizational theories in what we labelled "Patrolling the borders", "External Legitimation", "Reduction of Discretionality", and "Temporal Management". The identification of these problems enriches the scarce body of knowledge on the governance of blockchain systems, resulting in a better understanding of how blockchain governance links to existing concepts and how it is enacted in practice.

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3.1 Introduction

In recent years, blockchain technology has emerged from being an enabler of cryptocurrencies to become a novel architecture to transact, maintain, and share data in a decentralized manner. All over the globe, organizations of all sorts form consortia to explore the merits of this technology (Gratzke et al., 2017). These merits vary from product innovation or optimization of inter-organizational business processes by replacing third-party authentication with an algorithmic one that blockchain technology natively provides. After years of research in this field, it became clear that blockchain systems are at the same time a new instantiations of known research problems – hence 'old wine in new bottles' in the title – and also present some novel dynamics, which require to be understood – hence 'walking in someone else's shoes' – to revise our theoretical views. Indeed, three of the six decision problems we identified clearly relate to existing IS research problems. The other three are blockchain specific.

Despite all the enthusiasm, how those efforts are governed – also beyond who is formally in charge – remains an open question. The history of research on open as well as inter-organizational collaboration is long (Benkler, 2006, 2017); despite being fundamentally different, collaboration in both settings has not always been fruitful, often for common reasons like mistrust, or vested interests (Cao & Zhang, 2011; Fawcett et al., 2015). Our research sees governance through the narrow lens of decision problems and their corresponding solutions, thus shedding light on how blockchain systems are governed in open and inter-organizational settings. Then, theoretical implications of those findings are discussed.

Little is known about decision problems in the blockchain domain and how solutions can be found and enforced in blockchain systems (Walport, 2016). There is a plethora of domain-specific governance frameworks in IT, in the corporate realm, public administration, and many more; while first steps have been made (Beck et al., 2018), a governance framework for blockchain systems in general, for example, examining the generic roles, responsibilities, decision rights, or incentives of actors in a blockchain system is yet to be defined. This gap in scientific literature and the practical relevance highlighted by the steadily increasing number of blockchain projects motivates our research. From both existing academic literature and our own cases, we (1) derive six decision problems within the blockchain domain (domain problem), (2) relate these to their root problem (abstract problem), and (3) shed light on blockchain-specific solutions to overcome these problems (domain solution). The latter is illustrated in a number of cases studied through semi-structured expert interviews with representatives from those cases and other complementary data. Studying their enactment revealed their relevance to major organizational theories in what we labelled "Patrolling the borders", "External Legitimation", "Reduction of Discretionality", and "Temporal Management".

This research answers the incumbent call for research on how blockchain systems are governed (Beck et al., 2018; Campbell-Verduyn, 2017); not only to improve their well-functioning from an organizational perspective (Miscione et al., 2018), but also to anticipate future inhibitors that may arise and the changes they bring to various domains (De Filippi & Loveluck, 2016a). Therefore, this research answers the following research questions:

RQ1: What are major decision problems in blockchain systems?

RQ2: How are those problems dealt with in practice?

RQ3: What is the theoretical relevance of blockchain peculiarities?

The following section *Literature Review* provides an introduction to the research topic and introduces the reader to the field of governance in general as well as from a blockchain perspective. Next, within *Methodology*, we detail the underlying methodology in this research, followed by *Shaping Our Lens: A Focus on Decision Problems*, which presents the first part of our results with a narrow focus on blockchain decision problems. *Applying our Lens: Zooming in on Blockchain Governance Problems* then shows how these decisions are enacted within the application domains of supply chains, land registries, cryptocurrencies, and intellectual property rights management. Consequently, we discuss our results against the background of the works identified in *Literature Review* and well-established theoretical angles in *What Has Our Lens Made Visible?* Lastly, we conclude our work by giving an outlook for future research avenues within *Conclusion*.

3.2 Literature Review

The body of literature on blockchain has grown considerably, going well beyond its origins in engineering approaches. This section highlights the cornerstones of this literature. Before diving into them, we would like to anticipate that after we define and use our lens on the base of theorical and empirical work, we will be discussing our findings against broader theoretical concerns like: dichotomy of agency and context, legitimacy, uncertainty and risk in tightly coupled systems, and mis-matching timeframes.

3.2.1 Blockchain Systems

As this paper centers on governance, a technical explanation of how blockchains work is not considered here beyond what is directly relevant to our focus. To grasp the main differences in decision-making processes that blockchain offers, it is helpful to start with existing classifications of blockchain systems and to outline their main characteristics. A blockchain system is hereby defined as the underlying technology (blockchain) and its organizational embedment (the community surrounding the blockchain and its utilization). Following the notion of Peters and Panayi (2015), a classification of blockchain systems can be seen along the access to transactions (public or private) and transaction validation rights (permissioned or permissionless), as seen in table 13.

		Access to Transaction Validation	
		Permissioned	**Permissionless**
Access to Transactions	**Public**	All nodes can read/submit transactions; authorized nodes validate transactions.	All nodes can read, submit, and validate transactions.
	Private	Only authorized nodes can read, submit, and validate transactions.	N/A

Table 13. Classification of Blockchain Types, adapted from Peters and Panayi (2015)

A blockchain system can provide trustworthy data (in the sense of trust in the maintainer of the system) to the extent that reliable data is entered in the first place (Miscione et al., 2018). This reliability is fostered through the blockchain's characteristics of decentralization (no central entity), persistency (transactions cannot be deleted), auditability (traceability of events), and anonymity (key pair authentication) (DuPont & Maurer, 2015; Zheng et al., 2017a); the latter may vary depending on the type of blockchain system utilized.

3.2.2 Perspectives on Governance

The term governance is used with different meanings in different application domains, with the most prominent being political (Fukuyama, 2013), IT (Weill, 2004), and social sciences (Chhotray & Stoker, 2009). According to well-known works from social sciences, modes of governance can be classified into markets, hierarchies, and networks (Powell, 1990; Williamson, 1975a). For our work, we understand governance as the means for organizational and economic coordination utilizing decision rights, incentives, and accountabilities (Beck et al., 2018), while we take a narrow empirical stance on decision problems. Decision-making rights and their enactment are thereby placed either on the individual actors' level (markets, free choice), the formal organization's level (hierarchy, authority), or the consortia's level (networks, consensus). To understand the nature of how decision rights are allocated and enacted in blockchain systems, the overall process of alignment, translation, and deployment of business goals into technological outcomes has to be understood. Hence, we consider the broader notion of the governance of IT systems; this lens is helpful to understand the interplay between the emergence of requirements towards a technology and the factors that assure its successful implementation (De Haes & Van Grembergen, 2004). Weill (2004) defined five core decisions to be made: IT principles (how IT is used in business), IT architecture (technical choices), IT infrastructure strategies (strategies for base foundation), business application needs (specifying business needs for development), and IT investment and prioritization (decisions on how project approval is made). This is not to assume IT only evolves within walled-off corporate environments. The history of inter-organizational systems is rich, specifically in business networks with high inter-organizational dependencies, such as supply chain management (Mentzer et al., 2001). The collaborative use of information technology (Prajogo & Olhager, 2012), or informational integration in general (Chen et al., 2007; Joakim Kembro & Kostas Selviaridis, 2015), have frequently been considered of paramount interest, most recently for blockchain systems (Nakasumi, 2017). These efforts resulted in a de facto standard for electronic data interchange (EDI) and other collaborative planning methods such as efficient consumer response (ECR) or collaborative planning, forecasting, and replenishment (CPFR).

It is important to note, that blockchain systems have their origins in the free-and-open-source-software (FOSS) mode of production, which gained momentum from the late 90s. FOSS development exemplifies a mode of governance in the open (Demil & Lecocq, 2006) known as commons-based peer production (Benkler, 2017). It gained prominence by successfully developing successfully foundational technologies that a vast number of systems depend upon (e.g., Linux). This mode of governance is marked by no central steering entity, constant forks, and, hence, a high customization of software towards a single user's needs. While authoritative actors emerge (e.g., Linus Torvalds with Linux), the absence of a formal authority, hence, raises the question of incentives and practices (Krogh et al., 2012). Even though blockchain technology finds its origins in the world of FOSS, and inherits some of its traits, some key decisions – mainly related to the immutability of the ledger – are peculiar and require specific attention.

3.2.3 Governance of Blockchain Systems

Public and permissionless blockchain systems, such as Bitcoin or Ethereum, have received increasing attention from researchers (Campbell-Verduyn, 2017; DuPont, 2017; Morabito, 2017a; Reijers et al., 2016). The governance of these systems can be characterized as tribal (Miscione et al., 2018). As in tribes, actors tend to organize in loosely defined groups with shared interests and values. When interests diverge, some have the chance to branch out (forking) and create their own tribe (fork). Each tribe relies on a certain “togetherness” (Miscione et al., 2018) to maintain the system. Incentives to influence the other actors’ behavior hence emerge as crucial components in order to keep up with those mutual interests. The architects of those systems, for the initial design as well as later enhancements, are typically core developers (e.g., (Bitcoin Core, 2010/2018)). Open source principles, which are commonly adopted here and allow users to propose changes to the system as they see fit, can be supported by developers, but – differently from other FOSS projects – they need the agreement of other core actors, especially miners and token-owners. Having no entity formally in charge (Morabito, 2017a), those decision-making processes are often painfully complicated and ineffective, leading to governance crises that pose constant threats to the “tribe” (De Filippi & Loveluck, 2016a).

This is not to say that a public and permissionless blockchain’s decision-making shall be seen as completely decentralized. A number of authors (Dwyer, 2015; Hsieh et al., 2017; Reijers et al., 2016; Walport, 2016; Zheng et al., 2017a) studied Bitcoin’s governance and concluded the decision-making power to be unevenly distributed. Their arguments include inter alia (1) the inequality of mining power distribution and (2) the privileged standing of core developers in terms of software development. Glaser (2017) also concedes that actual software development in blockchain systems is tightly bound to the control over the entire system. While the decision-making process involves miners, users and developers, prominent figures (e.g., Vitalik Buterin for Ethereum, Gavin Andresen for Bitcoin to a lesser extent) hold major influence over these systems; however, differently from other information systems, the developers’ or public opinion leaders’ influence can be counterbalanced by either miners’ or users’ (Morabito, 2017a; Walport, 2016).

In the blockchain domain there is increasing awareness of those past governance issues and the shortcomings of the reductive assumptions associated with “code-is-law” (De Filippi & Loveluck, 2016a; DuPont, 2017). Current governance problems open up two ways forward (Miscione, Klein, et al., 2019): Either, (1) blockchain communities push ‘code-is-law’ further (i.e., “more-of-the-same”) but in a more robust manner, as seen in the development of on-chain governance structures within decentralized autonomous organizations[3] (DAOs), or (2) formal control in the form of off-chain governance bodies (e.g. foundations, consortia) has to be established. The prospect of authenticated records attracts interest from domains other than cryptocurrencies, contributing to the increasing popularity of permissioned blockchain systems led by consortia (e.g., R3 Corda). By their very nature, permissioned blockchains vary from permissionless ones in the restriction of validation or access rights or both (Peters & Panayi, 2015). Agreement upon data validity is thereby dependent on both well-allocated rights to write data (content) to the ledger and an appropriate consensus algorithm to preserve its state. Further, the notion of smart contracts brings a form of algorithmic decision-making, providing an agreed-upon, deterministic sequence of events based on input criteria (Gatteschi et al., 2018; Kitchin, 2017).

Like other information systems, blockchain systems are subject to change over time (Nitto et al., 2008). In a similar vein, Morabito (2017) describes the importance of studying the impact and the challenges brought by the evolution of decentralized blockchain-based systems and their governance. In addition, Walport (2016) stresses that the successful implementation of blockchains requires adherence to the duality of both legal and algorithmic rule frameworks. Regulation of blockchain systems is also central to Okada et al. (2017): they discuss different modes of authority, incentive placements and the resulting consequences for blockchain systems.

Drawn from the previous arguments, it is clear that forms of organizing, and hence the decision-making process, in and around blockchain systems vary greatly. Thus, decision rights are hard to define and assign. It remains unexplored which decisions are deemed central to blockchain systems and which actors or organizations actually sit in the driver's seat, if there is one at all, and steer the development of blockchain systems. This demands exploration in the field.

3.3 Methodology

This research is product of a bottom-up, exploratory research. Therefore, no unique theoretical framework has driven our research design and process. This explains why we conclude proposing a toolkit instead of a unique conceptual view. This paper is embedded in

[3] Decentralized Autonomous Organizations (DAOs): Virtual organizations run by agreed upon code. Famous, and heavily funded (>US$500 million combined) examples include EOS (https://eos.io), Tezos (https://tezos.foundation), Aragon (https://aragon.one), The Decentralized Autonomous Organization, and D-Finity (https://dfinity.org)

a multi-year and multi-researcher study to explore blockchain systems in general and blockchain governance-related issues in particular. In terms of background, our research team covers information systems, organization studies, and design science expertise. This diversity allowed us, over the years of our common research, to triangulate our interpretations in an interdisciplinary manner. In addition, to continuously monitor and discuss developments in the blockchain domain light of its peculiar mode of governance, and to set them in relation to observations of our first studies on cryptocurrencies, a global, multi-disciplinary community of interest called Coding Value[4] was founded, comprising over 200 experts from academia as well as from practice.

As for the choice of methodologies to shed light on blockchain organizing in an exploratory manner, we proceeded as follows: following the actor-network-theory mantra of “follow the actors” – initially, in our case, a narrow view on blockchain developers – did not pay tribute to the interdependence of several actors that blockchain systems depend upon, as we argue above. In addition, blockchain developers tend to stay hidden, while other actors such as users are arguably in the millions. Another approach would have been to “follow the actions” (Czarniawska, 2014), which would have allowed us to be agnostic about the actors, but still would not have paid tribute to the scale the blockchain domain has reached over time.

Instead of following the actors (tend to stay hidden) or the actions (scale), it became visible from our project observations, discussions, and press articles, that those related to blockchain projects or crypto in general shared a common sense of what manifested central problems. Building upon this thought led us to our approach to follow problems as they materialized and, in particular, how they were being dealt with (Hoppe, 2011). The fluidity of blockchain projects’ members, the actors’ underlying compatible interests, as well as shared values defined their mode of organizing, rather than clear organizational associations or stable identities, which led us to the approach of studying blockchain systems through the lens of a social movement (Hargrave & Van De Ven, 2006). This line of thought corresponds to our focus on organizing beyond formal organizations, and it pairs well with the postulated need to abandon the assumptions of (1) encapsulating information within organizations as if they were containers, and that (2) higher organizational levels disperse elements of work (Winter et al., 2014). We extended this thought accordingly: context as well as agency, as Hayes and Westrup argue (2013), are not pre-given but network-dependent. This is in line with the context of reference for cryptocurrencies, which does not pre-exist this phenomenon: the

[4] https://codingvalue.weebly.com

growth of crypto fostered interactions between organizations, users, regulators, developers, geopolitics, etc. Therefore, our methodological stance stems from studying online practices as well as the modality in which these are performed as part of organizing processes, rather than seeing these through the lens of formal organizations (Czarniawska, 2014).

Before specifying the methodology of this research and its narrow focus on decision problems, we set this research in context to already published works. As for our overall research output so far, initially, we focused on the understanding of properties of blockchain organizing from a general perspective. This was pursued within a first study on the significant empirical cases of land registries, which allowed us to put blockchain's peculiarities in the broader notion of common modes of governance (Miscione et al., 2018). But this study did not suffice to capture all peculiarities of blockchain organizing that emerged across different domains of application. In the time that followed, we narrowed our focus down to a more distinguished view between the peculiarities of organizing permissionless and permissioned blockchains. We built our argument on the empirical cases of land registries, several well-known cryptocurrencies, and cases from the supply chain domain, relating these to the notions of platforms and infrastructures (Ziolkowski et al., 2018) and the way these are said to be conflated in digital organizing (Plantin et al., 2016).

For this particular study, in the form of an exploratory study (Briggs & Schwabe, 2011; Stebbins, 2001), we ensured a wide coverage of information and (1) derived codes based on practitioners' view and scientific literature, (2) found suitable cases to which we could apply those codes (interviews), and (3) utilized internal as well as external feedback for sense-making (data analysis and evaluation and refinement). Following these steps gave us a rich empirical basis which is, due to length limitations, only partly reported here.

Step 1: Literature Review. In developing an appropriate lens to study decision problems in blockchain systems, we were able to rely on a specialized and up-to-date literature basis established over the years and utilized by several researchers. Nevertheless, we strove to review the literature for the specificities of our research. In a first step, the scope of the search was set on governance in general, IT governance, its specificities of organizing, and how it translates to the blockchain realm. To ensure a consistent search, we first specified what is commonly understood as governance, and which parts we would specifically address. Next, we searched for literature on the main global repositories (ACM, Scopus, and Google Scholar), utilizing the following search terms (and their variations): "Blockchain governance", "inter-organizational governance", "shared governance", "blockchain decision-making", and "decentralized governance". This was a necessary step to identify, in how far our observations from other cases translate into academic discourse in order to find major decision problems in blockchain projects (RQ1). Within this search, only blockchain-related articles were considered. These articles can be found in the description of a decision problem below. To ensure an overview as comprehensive as possible, and to also include practitioners' views on blockchain governance, a number of further information sources were used (as described in step 3).

Step 2: Expert Interviews. To study how organizations meet these decision problems in practice (RQ2), we searched for mature blockchain systems as our empirical field. This proved difficult because blockchain's recent emergence has not allowed for many well-established systems. To ensure a comprehensive search, we utilized CoinDesk and CrunchBase (widely considered the most authoritative specialized news sources), and LinkedIn, and compiled a list of several hundred cases. Within this longlist, based on short case descriptions, we initially clustered along the four domains we aimed to study: supply chain management, intellectual property rights management, land registries, and cryptocurrencies. These domains were considered the most mature at the time of writing. Consequently, from a shortlist of cases we considered most likely to have the best organizational maturity based on media coverage, employee count, or starting year of project, we invited representatives for expert interviews, of which 18 accepted our invitations (see table 14). We thereby paid attention to maintain an even, thus comparable, number of cases (at least 3) per domain. As we could not triangulate one of these cases with other data, this case has been dismissed for consistency and comparability of results. It is important to note that our research design was informed by theoretical sampling: instead of aiming at a representative sample of a given population, we focused on classes of applications, then actually cases relevant to the problems we aimed to study; several cases were also brought forward and discussed within Coding Value. The interviews took the form of semi-structured expert interviews (Myers & Newman, 2007) and were recorded and transcribed for coding. We thereby created an interview guide inhering general questions, as well as permissionless- and permissioned-blockchain-specific questions, and we carefully adapted our interview guide throughout our research. In some cases, two representatives from the same company but in different positions were interviewed, allowing us to gain different perspectives on the same case, thus triangulating our interpretations.

Step 3: Grey Literature Review. As a background and complementary source of information to expert interviews, whitepapers and a range of supporting documentation regarding these cases were helpful in understanding the features of each blockchain system and its high-level architecture. The purpose of this step was not to be dependent solely on interview statements, but to clarify (triangulate) interview statements, ensuring the internal validity of our methodology. Each blockchain initiative's website thereby served as a starting point for our search, and these proved to be helpful sources of information as they reflected opinions on the topic and addressed issues experienced by those initiatives. To not limit our data to our studied companies' views, we also strove to include press and opinion articles (e.g., on CoinDesk) on these cases written by externals. This allowed us to put their cases and anticipated risks in a broader context.

Step 4: Data Analysis. To begin the sense-making process, we analyzed relevant grey literature and interview transcriptions. The objective of using multiple sources of data was to compare and cross-check the data collected through interviews with different perspectives and triangulate our interpretations. Each interview was transcribed and coded. To achieve a rough understanding of our cases and to grasp their general properties, our initial coding dimensions centered around (1) the involved actors and their responsibilities, (2) the type of blockchain in use, (3) the chosen consensus mechanism, (4) decisions taken by the actors (5), the current phase of the project, and (6) the expected advantages of using blockchain technology. As argued before, our lens has been informed by the wider frame of our overall research and refined in the analysis of our studied cases. Hence, in a subsequent coding step, we applied our lens to our cases for a comprehensive overview of each decision problem across cases. The results of this analysis concerned major blockchain governance decision problems as well as their enactment in practice, as described in the subsequent sections *Shaping Our Lens: A Focus on Decision Problems* and *Applying our Lens: Zooming in on Blockchain Governance Problems*.

Step 5: Evaluation and Refinement. Within our research, we iteratively sought feedback. Once an iteration of our results was conducted, we sought feedback by making our results available to co-researchers, practitioners working in the blockchain realm, major information systems conferences, and specialized workshops. This phase was conducted in an iterative fashion until saturation was achieved. The experts' feedback was then considered appropriately in the further design of this research.

Date	Interview	Case	Domain	Location	Maturity	Type	Interviewee Role
29.05.17	I1	1	Land Registry	Ghana	PoC	Public/Permissioned	CEO
31.05.17	I2	2	Land Registry	Honduras	PoC	Permissioned	Project Manager
02.06.17	I3	3	Supply Chain	USA	Operational	Permissioned	IT Employee
20.10.17	I4	4	Cryptocurrency	Global	Operational	Permissionless	Team Coach

25.10.17	I5	5	Land Registry	Sweden	Completed PoC	Permissioned	Project Lead
26.10.17	I6	6	Cryptocurrency	Global	Operational	Permissionless	Project Lead
30.10.17	I7	7	Supply Chain	Switzerland	Conceptual	Permissioned	Board Member
31.10.17	I8	8	Cryptocurrency	Global	Conceptual	Permissionless	Project Lead
01.11.17	I9	9	Supply Chain	China	Conceptual	Permissioned	CEO / Founder
03.11.17	I10	10	IPR	Global	Completed PoC	Permissioned	Associate Director
07.11.17	I11	11	Supply Chain	Belgium	PoC	Permissioned	Co-founder / CPO
10.11.17	I12	10	IPR	Global	Conceptual	Permissioned	Application Engineer
17.11.17	I13	11	Supply Chain	Belgium	Completed PoC	Permissioned	Business Developer
17.11.17	I14	12	IPR	Global	Operational	Permissionless	Application Director
20.11.17	I15	13	Land Registry	Georgia	PoC	Public/Permissioned	Security Managers
23.11.17	I16	13	Land Registry	Georgia	Conceptual	Public/Permissioned	Project Manager
23.03.18	I17	14	Cryptocurrency	Switzerland	Completed PoC	Permissionless	CEO

Table 14. Interviewed Cases

3.4 Shaping Our Lens: A Focus on Decision Problems

To address RQ1, a review of academic literature, our extensive observations of blockchain projects, grey literature, and interviews revealed six major decision problems about blockchain governance (see table 15; see appendix 1 for complementary interviewee quotes). We describe each decision in the following and relate all of them first to the literature and, in the next section, to our cases. Building upon grey literature and expert interviews, we then detail the fashion in which they are enacted, targeting RQ2. The first three decisions listed below relate closely to conceptualizations of IT governance, thus this work focuses on adjusting them to blockchain specificities. The latter three are blockchain specific, thus they define blockchain governance and deserve particular attention.

3.4.1 Demand Management (DM)

Problem at hand. User needs and information systems are naturally subject to evolution in terms of scale, functions, throughput, or others (Nitto et al., 2008). To manage this evolution, there must be a way to (1) capture, (2) funnel, and (3) agree upon changes to a system. These processes are not specific to blockchain systems; they have been at the heart of the research on IT demand management (Legner & Löhe, 2012; Mckeen et al., 2012) and major corporate IT development frameworks in general (e.g., ITIL, COBIT). The fulfillment of IT demands is subject to intertwined processes encompassing requirements engineering (e.g., specification of requirements), enterprise architecture management (e.g., fit to overall enterprise architecture), portfolio management (e.g., decision upon demand portfolio planning), and project management (implementation/approval of demand) (Legner & Löhe, 2012).

Problems in Blockchain Systems. Practice has shown that blockchain systems are subject to change and that the way these changes are conducted is a key process. For example, the inability to achieve consensus on how to change its system led Bitcoin close to a stand-still, if not collapse, multiple times (De Filippi & Loveluck, 2016a), leading to numerous forks over time (Islam et al., 2019). Two of blockchain's key features are thereby affected: Immutability and decentralization. Undermining immutability – by means of forking the ledger to change the system – reverberates in the integrity of agreed upon functions, i.e. protocols or smart contracts (DuPont, 2017) and the overall credibility of the ledger. Walport (2016) strengthens this line of thought by arguing that in order to avoid degradation of the technology and to ensure longevity, blockchain systems should be continuously updated and enhanced. In addition, Okada et al. (Okada et al., 2017) emphasize the importance of organizational decision-making and a system's interoperability; also, standards ease challenges in interoperability as blockchains vary in codebase and infrastructure. Standards help organizations to select the most appropriate blockchain for their businesses (Kshetri, 2017), which has also been confirmed by several of our interviewees. As far as a blockchain system is decentralized, limited degrees of control can be applied, which was mentioned by several of our interviewees as a major hurdle. For example, changes to the system can be proposed, but other stakeholders can choose to decline them, which effectively disconnects them from the system (Islam et al., 2019). The system, on the other hand, relies on user participation for both the value of its token and its security (Ziolkowski et al., 2018). As a result, changes to the system are precarious but necessary as observed in practice (De Filippi & Loveluck, 2016a; DuPont, 2017) and must be conducted in a coordinated manner.

Solutions in the Blockchain Domain. Questions arise regarding how novel business requirements of a blockchain system should be gathered, decided upon, and implemented. For example, for different decision types (strategic, tactical, or operational), who would be involved and decide on the adjustments (e.g., single actors vs. consensus among many), and how would the decision be made (e.g., ad hoc vs. planned)? In addition, the actors vary and can be internal (e.g., users) or external (standard-setting bodies, regulators). As seen in our related work, the most prominent blockchains nowadays still rely on informal consensus-finding processes. Related to the two ways forward in blockchain governance introduced in our related work (Miscione, Klein, et al., 2019), DAOs seem to be a promising approach. They formalize demand management and associated processes and give users a (decentralized) means to make their voice heard (tokens). Change proposals are thereby brought forward by their users, collaboratively specified and discussed, and decided upon; the result of the vote is binding and sealed through smart contracts. DAOs have their origin in the code-is-law movement around The Decentralized Autonomous Organization (TheDAO)[5] (DuPont, 2017), and currently are being developed as what we termed code-is-constitution, meaning to define rules to change the rules.

3.4.2 Data Management (DAM)

Problem at Hand. Data lays ground for numerous digital technologies, such as modern decision-making systems (Janssen et al., 2017), analytical applications in supply chains (Hazen et al., 2014), or electronic data exchanges (Nicolaou et al., 2013). However, data's value depends on its quality, which is defined along the four dimensions of timeliness, accuracy, consistency, and completeness (Blake & Mangiameli, 2011; Hazen et al., 2014; Stentoft Arlbjørn & Haug, 2011). The assurance of data quality is consistently regarded as a primal goal of data management (Batini et al., 2009; GS1, 2014; Otto et al., 2012; Pentek et al., 2017), which Pentek et al. (2017) summarize to "(…) include[s] the formulation of a data strategy, the definition of data management processes, standards, measures, the assignment of roles and responsibilities, the description of data lifecycle and architecture, and the management of applications and systems." To cope with data quality challenges, a plethora of

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[5] The Decentralized Autonomous Organization: At it's time the largest crowdfunding project to date. A malfunctioning smart contract led to the loss of a significant amount of its funds. The discussion on how to proceed – reverting the malfunction or living with the consequences of lost funds – caused heated debates, resulting in the split of Ethereum's community (DuPont, 2017).

reference guides or data management frameworks have been developed, such as the CDQ framework[6] or the DGI Data Governance Framework[7].

Problems in Blockchain Systems. How to manage data in blockchain systems is consistently seen as a major issue, as shown in its research stream (Anh et al., 2018; Eberhardt & Tai, 2017; Morabito, 2017a; Swan, 2015), especially when the handling of private data demands regulatory compliance (Bell, 2016; Berberich & Steiner, 2016). Data management in blockchain systems regards, broadly speaking, two aspects: data input and data preservation. The underlying issue of data preservation regards the fact that blockchain systems do not solely maintain data locally, but in collaboration with others through mining (Morabito, 2017a). But, in order to be well-functioning, data must be synchronous among all node holders at the same time, which is at the heart of blockchains' consensus algorithms (Cachin, 2017). These design choices, on the other hand, can lead to performance issues when blockchain systems grow in number of processed transactions, as exemplified by Bitcoin's scaling debate (De Filippi & Loveluck, 2016a) but is also seen on other platforms (Anh et al., 2018). So, the way the data processing architecture is designed has an influence on the system's performance (Anh et al., 2018). It's noteworthy, that the inability to reach a transaction throughput comparable to conventional databases has so far rendered blockchain technology unsuitable for high-frequency use-cases like micropayments (Anh et al., 2018; Croman et al., 2016).

Blockchains promise to overcome data quality issues in terms of consistency and timeliness among several actors by providing a single sourcing point, which is consistently named a top reason to deploy blockchain (Gratzke et al., 2017; Ziolkowski et al., 2018). While data in fact can be consistent and timely, its quality is not proven by blockchain itself. The underlying issue of data input therefore regards the inability of other actors to assess the rightfulness of entered data to the system. This effect is generally known as "garbage in, garbage out," referring to the varying quality of data inflow into a system and its consequent processing (Babich & Hilary, 2020; Bateman & Cottrill, 2017). Blockchain systems are particularly exposed to this problem because immutability extends the longevity of data of poor quality. In addition, users may avoid entering data as they could be held liable for wrongful entries after all (Berberich & Steiner, 2016). Along this line, interviewee I1 points out: "(…) it's not (about) replacing the notaries' jobs, it's (about) making their jobs easier. (…) we are not saying: 'Hey, our technology is going to automate everything', because you can't automate quality control." Since blockchain's immutability constrains greatly data handling, one has to foresee

[6] https://www.cc-cdq.ch/cdq-framework
[7] http://www.datagovernance.com/the-dgi-framework/

the possibility of changing, deleting, or amending data when erroneous data has been entered or a new data regulation becomes effective, as currently seen with the GDPR in Europe (Berberich & Steiner, 2016).

Solutions in the Blockchain Domain. Data preservation can be handled through technical choices, such as the placement of nodes, the choice of consensus algorithms, the design of the underlying protocol; blockchain's immutability thereby assures that once entered, data stays the same, unless its change is demanded and agreed upon. The placement of nodes regards choosing whom to allow the access to transactions and whom to allow to validate transaction proposals, which is reflected in the classification of blockchain systems in table 13 (Peters & Panayi, 2015). The mode in which transactions are validated refers to the choice of consensus algorithms, of which Bitcoin's proof-of-work is still the most used (Nakamoto 2008). In order to deal with performance issues, researchers as well as practitioners developed a number of alternative consensus algorithms, such as variations of proof-of-stake (Anh et al., 2018; Bartoletti et al., 2017) and proof-of-activity (Bentov et al., 2014). Proof-of-stake in particular is critically being debated as it divides validators along the number of tokens they hold (Buterin, 2014; Houy, 2014).

As for data input, it is important to differentiate between the storage of trivial (e.g., cryptocurrencies) and non-trivial (e.g., a list of attributes) data. In most cryptocurrencies to date, data is merely preserved and not further processed. In blockchain systems, which strive for process efficiencies (Bauer et al., 2020a; Zavolokina et al., 2020a), input data is stored for further, often automatically executed processing, which is highly dependent on high quality data. It is also important to differentiate between varying modes of storage of data on blockchains, such as concatenations of various chains to store various kinds of data (Bates, 2016) or storing hashes as pointers to off-chain data (Exonum, 2018). There are several ways of increasing data quality in blockchain systems: One possibility regards incentives for data provision (Zavolokina et al., 2018; Ziolkowski et al., 2018). For another, data input can be (1) delegated to trusted parties (e.g., notaries) or (2) delegated to IoT-devices (e.g., sensors), as observed in our studied cases, (3) assured through so-called oracles (Swan, 2015), which feed data from an external source, or (4) validated through data triangulation with different sources using smart contracts (Ziolkowski et al., 2018). Several researchers are also working on solutions for deleting, changing, or amending data without affecting the system's data integrity. Their approaches include secure multiparty computation (Andrychowicz et al., 2014), redactable blockchains (Ateniese et al., 2017), and mutable blockchains (Puddu et al., 2017). In any case, it is worth mentioning that the immutability of the ledger may dissuade poor quality input to the extent that data enterers are aware that ledger transparency makes it easier to be found out later on.

3.4.3 System Architecture Design and System Development (SAD)

Problem at Hand. Information systems are the product of a design process and are therefore always subject to interpretation (Bloomfield & Danieli, 1995; Oinas-Kukkonen & Harjumaa, 2009). There are several factors that define the design and maintenance of information systems, such as technical constraints (Aniche et al., 2019), varying design processes (Razavian et al., 2016) and modes of production (Li et al., 2013), and its socio-technical framing (Seth et al., 2014). The Open Group Architecture Framework (TOGAF[8]), an established and well-known enterprise architecture design framework, comprises the phases of designing, planning, implementing, and governing an enterprise IT architecture, modeled on the four layers of business, application, data, and technology. TOGAF, as well as many other enterprise architecture frameworks, arose from the need for a governance means in terms of oversight and coordination to deal with the increasing complexity of IT landscapes within and among enterprises (Ahlemann et al., 2012; Brosius et al., 2017). This includes the setting of enterprise-wide objectives and control mechanisms for varying IT development arrangements (Schilling et al., 2018) and aligning business needs with IT demands (Ahlemann et al., 2012). According to Brosius et al. (2017), Schmidt and Buxmann (2011) as well as Lange et al. (2016), enterprise architecture management is generally said to aim "(…) at effectiveness outcomes (e.g., the achievement of business goals and business-IT alignment), efficiency outcomes (e.g., mitigated IS landscape complexity, harmonized IS solutions), and general flexibility outcomes (e.g., utilization of applications) (…)."

Problems in Blockchain Systems. Once deployed, blockchain systems are hard to change (Miscione, Klein, et al., 2019). Later changes require consensus among actors (as seen under demand management), and subsequent forks[9]. The initial architecture design as well as its subsequent development must therefore be well-coordinated, which is in line with several of our interviewees as well as literature (Miscione, Klein, et al., 2019; Zavolokina et al., 2020a). We named this process system architecture design and development, which describes who decides the requirements and functionalities of the initial as well as consequent blockchain

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[8] https://www.opengroup.org/togaf

[9] There are several types of forks (i.e., soft- and hard forks) that vary in scope and consequences. For reasons of simplicity, we use the term "fork" interchangeably throughout this paper.

system, for example, which technology is to be used, or how to ensure the system's interoperability when concatenated with other systems.

The decentralization of blockchain thereby limits the degree of control that can be applied (Morabito, 2017a). This has paramount implications for the development and design of information systems: Without points of oversight and coordination processes, a goal-oriented and collaborative development of information technology under the measure of effectiveness, efficiency, and flexibility outcomes is highly exacerbated. Developers are arguably central stakeholders in blockchain systems as they have a major influence on the system's design and modes of maintenance (F. Glaser, 2017; Hsieh et al., 2017; Walport, 2016). Their centrality has two effects: These systems become increasingly dependent on the expert knowledge developers build over time, which then makes them quasi un-substitutable (De Filippi & Loveluck, 2016a). For example, Bitcoin's codebase, initially a rather basic blockchain system, became exponentially complex over time (Bitcoin Core, 2010/2018). This also has governance implications as their expertise allows them to make better-informed decisions on the future system design. This is particularly precarious in cases where developers and users do not agree on how to proceed. Both Bitcoin and the Ethereum have shown their dependence on their core developers or influential figures in times of crisis multiple times (De Filippi & Loveluck, 2016a; DuPont, 2017). And their work is by no means perfect, as exemplified by the example of TheDAO, whose bug was produced not by amateurs but by a leading group of developers (DuPont, 2019).

Solutions in the Blockchain Domain. It is evident in the blockchain domain, that the focal points of oversight and coordination are recognized as important pillars of their communities for system development and maintenance. To improve their practices, several DAOs founded foundations (e.g. Tezos, EOS, Ethereum) to (1) serve as a focal point of reference in terms of project and development progress and (2) allocate and budget funds for further system development. In contrast, in Bitcoin there have been limited points of oversight and coordination over time (De Filippi & Loveluck, 2016a). Most of the design and development has been conducted in a rather informal fashion and occurs either between core developers or in discussions in so-called Bitcoin Improvement Proposals (BIPs) in forums or GitHub (Swan, 2015).

Our cases show that system architecture design and development is often performed by either open source developers, an internal IT department, or a professional software development team, but always in collaboration with business stakeholders or its users. Several interviewees building public blockchain systems confirmed thereby the centrality of IT developers in their respective systems. Within several of our studied permissioned systems, our interviewees did not confirm their developers' centrality. In several of our cases there were procedures in place dictating how to develop and deploy code to production.

3.4.4 Membership (M)

Problems in Blockchain Systems. In order to avoid undesired behavior of users towards the system, platforms or information systems of any kind, explicitly or implicitly, have a built-in user management that defines an action space per user type (Jøsang & Pope, 2005). This discrimination is a necessary control mechanism and is designed by the party in charge of the system. As exemplified by the previous decisions, blockchain systems rely on consensus forming among their users. To ease this process, blockchains strive to keep human intervention to a minimum, also by predefining users' rights (Okada et al., 2017; Peters & Panayi, 2015). A fundamental decision regards thereby which users are allowed to read which transactions or to validate incoming ones. This decision has to be made with great care as it affects the openness of the platform, reliability of the ledger, system performance (Anh et al., 2018), and also privacy (Berberich & Steiner, 2016) issues. This decision is also motivated by the issue that blockchains broadcast all transactions to the entire network, making them, in theory, readable for all node holders, which is in contrast to distributed ledger systems (Babich & Hilary, 2020). Blockchain systems that compartmentalize different kinds of data are aware of these issues and establish identity assessment processes to grant read or write permissions only on subsets of data (Azaria et al., 2016; Ziolkowski et al., 2018).

If permissions to read or write data have to be granted based on user type, there must be ways of certifying users' identities. These roles, which we label gatekeepers, effectively steer the in- and outflow of users of the system. The definition of gatekeepers thereby is a central theme, raises the issue of inter-personal trust, and must be done with great care. The decision on membership in blockchains thereby regards both the assignment of read and write rights per user type as identity management as well as modes to entry/exit blockchain systems.

Solutions in the Blockchain Domain. The mode of entry or exit in blockchain systems depends highly on the type of blockchain in question (as seen in table 13). Public permissionless and permissioned systems, by definition, do not explicitly define procedures for entry or exit. In Bitcoin (public permissionless) or Dash[10] (permissioned public) for example, users are free to join or to leave the network as they see fit. Permissioned private

[10] https://www.dash.org

blockchains differ in this regard, as Okada et al. (2017) stress the importance of a trusted authority who has the power over the system and can grant or deny permission to participate in the system, which is in line with several of our studied cases. I8 comments on central onboarding rights: "(...) the nodes are identified in the sense that they can only get smart contracts when the [central] node gives them access to the network. (...) which nodes have access to the network is governed by the community in our case." I1 comments on the importance of identities: "(...) this is where establishing identity control points is [important] (...). There is not going to be someone working within our system that we can't identify." Identity management also relates to the classification seen in table 13, dealing with the specific rights a user has upon entry to the system. In Bitcoin, for example, read and write rights are defined as open and participation is explicitly required (Pilkington, 2015; Zheng et al., 2017a). Public and permissioned blockchains relying on proof-of-stake consensus, such as Dash, only assign transaction validation rights to token holders. In private and permissioned blockchains, read and write permissions are monitored by central decision makers: Gatekeepers. Dealing with personal data (e.g., in land registry or automotive records (Benbunan-Fich & Castellanos, 2018; Ziolkowski et al., 2018)) requires a more fine-planned data access system. The type of identities thereby also gains prominence: Should users be anonymous, pseudonymous, or must there be a verified identity (e.g., for liability reasons)? The latter regards legality of actions and interoperability to public government infrastructures for identity verifications.

3.4.5 Ownership Disputes (OD)

Problems in Blockchain Systems. Ownership disputes are again unique to blockchain governance because they derive from the authenticity that blockchains grant. Blockchains allow for scarce data, which has two prospects: Clear data ownership and digital representation of physical assets. The former allows for an explicit assignment of property rights and control over personal data on data platforms through the use of a dedicated permission control system (Azaria et al., 2016; Ziolkowski et al., 2018). The latter regards the representation of physical assets through tokens (Oliveira et al., 2018) for a facilitated processing in the blockchain system (Lemieux, 2017), such as digitized land registry certificates (Benbunan-Fich & Castellanos, 2018). How to strengthen the link between digital and physical assets, however, is not resolved within the blockchain domain.

Solutions in the Blockchain Domain. With banks, fiat money serves as an allowance to be retrieved at an arbitrary cashier, and banks ensure the availability of that allowance to a certain degree. With the introduction of digitally verifiable assets, blockchains also introduced their own access systems: wallets. Having no physical representation of either one of these exacerbates the clear-cut allocation of ownership. While this technicality may be resolved, a pure digital ownership without legal grounding is hard to establish. What would happen if two users claimed ownership over the same asset? Blockchain systems must adhere therein to local jurisdiction, which has been frequently mentioned by our interviewees, and implement measures to reassign rightful ownership, which points at the importance of a clear-cut data management architecture. Interviewee I13 commented in this regard: “He can go to court to prove that he wasn't part of this deal and his property was stolen. The court will make a decision and the court will be using their authorized key [and] will publish the transaction in [the] blockchain that will say the property still owns to this person.” It becomes evident that in blockchains there is a need to identify actors who resolve conflicts when multiple users claim the same property or if wallets holding assets are not accessible anymore.

3.4.6 Transaction Reversal (TR)

Problems in Blockchain Systems. Transaction reversal regards measures taken into account when unforeseen events (e.g., hacks, theft, malfunctions) happen to an information system. In typical enterprise systems, transactions can be easily reversed. This is not the case in blockchain systems. A transaction reversal contradicts a blockchain’s immutability. This has been inevitable in exemplary cases in the past, like TheDAO outlined below. In these unforeseen events, stakeholders in a blockchain system must be empowered to reach consensus on how to proceed (Morabito, 2017a).

Solutions in the Blockchain Domain. A glaring example of a controversial transaction reversal – among others (Pauw, 2019) – can be seen in TheDAO (DuPont, 2017). But not only miscoded smart contracts can cause the need for transaction reversals: Bitcoin, as I4 points out, is constantly under the threat of being attacked: “(…) [the] bitcoin network is the most hacked network of any network ever seen in the eternity of computing. It's [been] hacked 600 to 700 times every day because there is a lot of value for that. (…) So, that’s why we know proof of stake and this private public key infrastructure is [generally] stable [although] it’s being hacked.” An effective means against hacks, as pointed out by further interviewees, seems to be concatenation of blockchains. Interviewee I5 regards checkpointing a state of data at a given time to another chain as a beneficial measure when agreement within one chain cannot be found. Concatenating even more chains is emphasized by I1: “Hacking one blockchain is next to impossible. Hacking four blockchains is obviously going to be exponentially more difficult than just one. It’s not [only] times four, it’s going to be a logarithmic increase of difficulty (...).” As for mistakes in data input, such as the wrongful transfer of ownership, I5 and I13 highlight the importance of not reverting a transaction for auditing reasons but to allocate a central, legitimized actor to write a new state of data into the ledger.

Considering common blockchain architectures, there is no way of restoring a wrongfully transferred asset or granting a new private key in case of its loss – but the asset could be granted to a new account (wallet) upon human intervention and consensus. I2 comments in this regard: “We’re still people and we still need centralized parties that help us resolve conflicts. Software doesn’t resolve conflict; it can just be a better record keeping system.”

Decision Problem	Problem at Hand	Problem in the Blockchain Domain	Solution in the Blockchain Domain
Demand Management	User needs and IT change (Nitto et al., 2008) Change process is central to several research streams (Legner & Löhe, 2012; Mckeen et al., 2012) This change process encompasses intertwined processes known from the corporate domain (Legner & Löhe, 2012).	Practice shows that blockchains change and their modality of change is a key process (Islam et al., 2019) (De Filippi & Loveluck, 2016a; DuPont, 2017). Immutability and decentralization are affected by change Limited degrees of control through decentralization exacerbate change (Islam et al., 2019), but co-dependence of actors demands a change process.	Nowadays, most blockchains rely on informal consensus processes. Two ways forward are emerging (Miscione, Klein, et al., 2019): Off-chain (Bitcoin, blockchain consortia, and others) On-chain (DAOs) coded consensus change processes.
Data Management	Data lays ground for numerous digital technologies (Janssen et al., 2017)(Hazen et al., 2014). Data's value depends on its quality, which relies on specific properties (Blake & Mangiameli, 2011; Hazen et al., 2014; Stentoft Arlbjørn & Haug, 2011) and is hard to be maintained (Batini et al., 2009; GS1, 2014; Otto et al., 2012; Pentek et al., 2017), while several frameworks offer guidance.	Data management in blockchains is a vital research stream (Anh et al., 2018; Eberhardt & Tai, 2017; Morabito, 2017a; Swan, 2015), especially for compliance (Bell, 2016; Berberich & Steiner, 2016) It regards two main aspects: data preservation and data input. Data preservation: Consensus algorithm ensures synchrony of data (Morabito, 2017a)(Cachin, 2017), while being dependent on technical performance criteria (De Filippi & Loveluck, 2016a)(Anh et al., 2018) Data input: "Garbage in, garbage out" referring to the varying quality of data inflow processing (Babich & Hilary, 2020; Bateman & Cottrill, 2017).	Data preservation can be handled inter alia through, Design of underlying protocol Placement of nodes and choice of consensus algorithm Data input: Differentiation between the storage of trivial and non-trivial data. Known possibilities Incentives for data provision (Zavolokina et al., 2018; Ziolkowski et al., 2018) Delegation of data input to trusted parties, IoT-devices (Swan, 2015), external systems, or data triangulation (Ziolkowski et al., 2018)
System Architecture Design and Development	IT landscapes become increasingly complex (Ahlemann et al., 2012; Brosius et al., 2017) while being contingent on individuals interpretation (Bloomfield & Danieli, 1995; Oinas-Kukkonen & Harjumaa, 2009), technical constraints (Aniche et al., 2019), varying design processes (Razavian et al., 2016) and modes of production (Li et al., 2013), and its socio-technical framing (Seth et al., 2014).	Once deployed, blockchain systems are hard to change (Miscione, Klein, et al., 2019). This path dependency requires a well-coordinated initial and subsequent architectural design (Miscione, Klein, et al., 2019; Zavolokina et al., 2020a), with limited control that can be applied (Morabito, 2017a). Developers are central stakeholders in blockchain systems (F. Glaser, 2017; Hsieh et al., 2017; Walport, 2016). Their centrality has two effects: Developers become quasi-in-substitutable (De Filippi & Loveluck, 2016a) Developers exert influence beyond technicalities	Bitcoin inhered limited points of oversight and coordination over time (De Filippi & Loveluck, 2016a), relying on informal discussions of core developers, so-called Bitcoin Improvement Proposals (BIPs), or coordination in forums or GitHub (Swan, 2015). DAOs founded foundations to (1) serve as a focal point of reference in terms of project and development progress and (2) to allocate and budget funds for further system development.

Membership	N/A: Blockchain specific	Blockchains strive to keep human intervention to a minimum, by predefining users' rights (Okada et al., 2017; Peters & Panayi, 2015), and by influencing the openness of the platform, system performance (Anh et al., 2018), and privacy (Berberich & Steiner, 2016) issues. Blockchain systems compartmentalizing different kinds of data necessitate an identity assessment processes to grant read or write permissions only on subsets of data (Azaria et al., 2016; Ziolkowski et al., 2018). Owners of these processes effectively steer the in- and outflow of users of the system, raising issues of inter-personal trust.	We observed several kinds of membership instantiations: In permissionless & public blockchains, read and write rights are defined as open and participation is required (Pilkington, 2015; Zheng et al., 2017a). Public & permissioned blockchains relying on proof-of-stake assign transaction validation rights to token holders. In private & permissioned blockchains, read and write permissions are assigned and monitored by gatekeepers.
Ownership Disputes	N/A: Blockchain specific	Blockchains allow for scarce data, which has two prospects: Clear data ownership and digital representation of physical assets. The former allows for an explicit assignment of property rights through the use of a dedicated permission control system (Azaria et al., 2016; Ziolkowski et al., 2018). The latter regards the representation of physical assets through tokens (Oliveira et al., 2018) for a facilitated processing in the blockchain system (Lemieux, 2017), such as digitized land registry certificates (Benbunan-Fich & Castellanos, 2018).	Wallets serve as a means to assess and maintain ownership of digital assets. As wallets and digital assets have no physical representation, the allocation of ownership is limited to the degree that it would not stand a legal claim upon ownership. We are not aware of ownership dispute resolution systems in the blockchain domain.
Transaction Reversal	N/A: Blockchain specific	Unforeseen events, such as hacks, theft, or malfunctions occur frequently within the blockchain domain. In typical enterprise systems, transactions can be easily reversed. For blockchains, a transaction reversal contradicts its immutability. This has been inevitable in exemplary cases in the past. In these unforeseen events, stakeholders in a blockchain system must be empowered to reach consensus on how to proceed (Morabito, 2017a).	An effective means against fraudulent transactions is the concatenation of blockchains, or so-called anchoring services. Considering common blockchain architectures, there are limited ways of restoring a wrongfully transferred asset or granting a new private key in case of its loss – but the asset could be granted to new accounts upon human intervention and consensus.

Table 15. Abbreviated Summary of Decision Problems, Problems at Hand, and Problems and Solutions in the Blockchain Domain

3.5 Applying our Lens: Zooming in on Blockchain Governance Problems

Deriving decision problems for blockchain systems (RQ1) served as a lens by which to see the decision problems that emerge from practice (RQ2). In the following, we illustrate their enactment in studied cases divided by domains.

3.5.1 Blockchains and Cryptocurrencies

With cryptocurrencies, there are differences observed, depending on the size of their community: In the case of Bitcoin, which is the largest studied case, demands are formulated and specified in online forums by any user, then agreed upon and implemented by developers; the adoption of a feature is then completed by deploying the updated version of the code to the user's node. However, major disagreements – especially about the block size (on which transaction volume and cost depend) – cannot be channeled by this process, resulting in repeated forks. But there are also rather hierarchically organized cryptocurrencies: Case 6, which is a Bitcoin fork, serves a rather small user base, and demand management is therefore conducted among its founders, then deployed to its users. Case 8 divides its user base in decision-making by assigning privileged rights to so-called master nodes, who decide among themselves which change to fund; however, proposals can still be proposed by anyone.

The case of blockchain-based cryptocurrencies concerns the first application area of blockchains overall. Table 16, below, illustrates the decision placement of cases 4 and 6, as well as case 8 (case 13 refers to a consortium and is hence not listed). In contrast to the previous cases, the blockchain-based cryptocurrencies are mostly built on public and permissionless ledgers, thus allowing members to partake in system architecture design and development (via community discussions and votes and all the typical processes of FOSS) as well as data management through mining (validating). In all systems, there is a group of core developers implementing the majority's will to their interpretation. There are limited measures (forks), however, if users conduct unintended transactions or seek support in disputes of asset ownership, pointing at blockchain's irreversibility. The initial design of the platforms, however, lays in the hands of its founders.

	Cases 4 and 14	Case 6	Case 8
DM	Users propose enhancements, developers decide	Team lead and two software developers	Users propose enhancements, auditors decide
SAD	Group of core developers	Anonymous developers	Company's core team members
TR	Individual user's responsibility	Individual user's responsibility	Individual user's responsibility
OD	Not applicable	Not applicable	Not applicable
M	Not applicable (Permissionless)	Not applicable (Permissionless)	Not applicable (Permissionless)
DAM	Consensus Algorithm	Consensus Algorithm	Consensus Algorithm

Table 16. Decision Problems Mapped to Cryptocurrency Cases

3.5.2 Blockchains and Intellectual Property Rights Management (IPR)

As for intellectual property rights management, we interviewed three experts from two companies (cases 10 and 12). Those projects aim to ease the management of intellectual property rights through unique identifiers and instant charges for usage of copyrights. Traditionally, those processes can be considered non-transparent and bureaucratic. The cases below illustrate the aspired blockchain system and the cases' decision placements (see table 17).

As for demand management, both systems vary in terms of decision-making power: While case 10 emphasizes the rather open, community-based vote, case 12 utilizes a permissioned system. Being backed by a foundation, case 10 derived its initial system architecture in collaboration with its users, while case 12's design is based on developer's choices. As for ownership disputes, both systems refer to actual courts. Data management is assured through consensus algorithms and the access to all transactions is public.

	Case 10	Case 12
DM	Company decides based on community vote	PoC: Consensus among stakeholders
SAD	Foundation, software provider	Company's core team members
TR	Individual user's responsibility	Individual user's responsibility
OD	Appeal to courts	Appeal to courts
M	Not applicable (Permissionless)	Not applicable (Permissionless)
DAM	Community based	Consensus Algorithm

Table 17. Decision Problems Mapped to IPR Cases

3.5.3 Blockchains and Supply Chains

Calls regarding supply chain inefficiencies and the need for informational and processual integration and transparency have been made for decades (Steinfield et al., 2011; Stevens & Johnson, 2016), but often went unheard (Cao & Zhang, 2011; Fawcett et al., 2015). Our collection of cases inheres four cases from the supply chain domain, partly varying in motivation to apply blockchain technology. Case 3 (platform developer, hence not mentioned in table 18) and case 9, for example, target the product flow (know-your-object) for not only cost efficiencies but also transparency along the supply chain. Case 7, on the other hand, utilizes IoT-sensors for good distribution practice, measuring and guaranteeing the temperature of medical goods to other supply chain participants. Case 11, a port administration in Belgium, aims to automatize the check-in and check-out of its hundreds of daily customers and their containers, storing a unique identifier for each of them in their blockchain system.

As can be seen in table 18, the decision rights for demand management are centralized in consortia, where formal consensus among stakeholders has to be found. This is also due to the permissioned nature of all blockchain systems. As case 11 regards a public function, the state imposes standards. Consortia and their (business) users consequently exhibit power over the system's architecture and its further development. As for the transaction reversals, all three use cases do not foresee measures to reverse those; this may be due to the fact that none of those cases are yet operational. In ownership disputes, all cases refer to courts. As for the membership, the systems of cases 7 and 9 plan to become permissioned and public: users may thus read entries, but validation is permissioned. Data management is assured through mining in cases 7 and 9, while case 11 utilizes a permissioned solution.

	Case 7	**Case 9**	**Case 11**
DM	External Consortium	External Consortium State sets standards	External Consortium State sets standards
SAD	Developers propose, consortium decides	Focal company in collaboration with state agency	Company decides, Consortium prioritizes
TR	Individual user's responsibility	Individual user's responsibility	Individual user's responsibility
OD	Appeal to courts	Appeal to courts	Appeal to courts
M	Not applicable	Not applicable	Port authority with companies
DAM	Sensor-based, Consensus Algorithm	Consensus Algorithm (PoS)	Contractual (Smart Contracts)

Table 18. Decision Problems Mapped to Supply Chain Cases

3.5.4 Blockchains and Land Registries

The prospect of registering land on a blockchain has gained increasing attention in recent years, predominantly in developing countries, where trust in formal authorities tends to be weaker. Blockchains could be used not only to replace third parties, but also to digitize paper-based and lengthy processes and to reduce costs. Our collection of cases considers four systems with similar goals (cases 1, 2, 5, and 13).

In the studied Land Registry systems, as a state function is performed, the state maintains the control over demand management, which resembles a hierarchical governance (see table 19). We acknowledge private and permissioned blockchains, when led by a single party, hardly constitute a novelty as their practices, based on our observations, do not differ from practices seen in the corporate domain. As a state function is performed, the state maintains control over the system architecture design and development as well as standards or enhancements. Further, the state assures data management through the ledger, through concatenation of different blockchains, as well as through closer collaboration with affiliates (notaries, banks), using auditory nodes. In case of transaction reversals or conflict resolution, a user must appeal to court. While the partaking actors in the ecosystem do not change, users still benefit from transparency and reliability of records.

	Cases 1, 2, and 13	**Case 5**
DM	Dictated by State Agency	Dictated by State Agency
SAD	State Agency and associated actors	State Agency
TR	Appeal to courts	Appeal to courts
OD	Appeal to courts	Appeal to courts
M	State Agency and affiliates	State Agency and affiliates
DAM	State Agency, Auditors	State Agency, Auditors

Table 19. Decision Problems Mapped to Land Registry Cases

3.6 What Has Our Lens Made Visible?

In *Shaping Our Lens: A Focus on Decision Problems*, we have identified decision problems that blockchain systems have to deal with; this answered RQ1. To answer RQ2, we have shown how those decision rights are mapped in a variety of cases in *Applying our Lens: Zooming in on Blockchain Governance Problems*. As for RQ3, a wider discussion follows. Considering the matrices produced by matching the main aspects of decision problems and the empirical domains of application, we have distilled the main points that characterize blockchain governance and thus influence the types of decisions to be made (RQ1) as well as their enactment (RQ2) as follows: 1) patrolling borders, 2) external legitimation, 3) reduction of discretionality, and 4) temporal management. After references to the previous sections, each of these types is discussed in its theoretical relevance. This offers a theoretical toolkit, rather than a unified theory, for theoretically informed analyses of blockchain systems and beyond.

Patrolling Borders. A general problem of distributed systems, which acquires a peculiar flavor in blockchains, is the definition of who is in and who is out. FOSS is defined by abolishing any formal barrier to inclusion, and the same applies to blockchains to the extent that software production is involved. However, since the value of what blockchains authenticate derives also from miners/maintainers and users, different sorts of border controls are in place (Ziolkowski et al., 2019). Related to previous cases, it is remarkable how in permissioned blockchains, patrolling the borders is a far-reaching and effective control mechanism. In fact, since once an actor is in, preset rules apply, keeping actors out is an effective tool to avoid undesired behaviors. Governance issues from other cases, such as centralization of mining power, coordinated takeovers (De Filippi & Loveluck, 2016a), or even take-downs (DuPont, 2017) are hereby counterbalanced through a steering body and a partly walled-off system. Unless another actor's identity is stolen, the blockchain avoids unwanted access (DuPont & Maurer, 2015). Even then, the clear audit trail of a blockchain (Snow et al., 2014) would allow the tracing back of misbehavior and reversal of transactions (in permissioned systems). Using unique and verified identifiers is well exemplified by the case of a Belgian port authority (case 11), where the monitoring of in- and out-flow is automatized, reducing governance costs of oversight. In more general terms, controlling the in- and out-flow of any resource can be an effective management tool in systems characterized by low to no hierarchy among the insiders.

In any formal organization, there are ways of defining who is in or out. In the market, disposable capital is the main definer. The above blockchain cases suggests the analogy of a club, whose main distinction is between inside and outside, members and the rest of the world. Contemporary information systems, and thus their analyses (Winter et al., 2014), need to acknowledge that the in or out distinction does not necessarily correspond – in fact it often does not correspond – to formal organizational boundaries. Indeed, the value of a club is exactly in allowing members' relationships across companies, public and private sectors, professions, and the like. A club's function as boundary spanner - while creating and policing its own boundaries – shows how organizations may also be obstacles to organizing (Czarniawska, 2014), that is, there are valuable organizational actions that would be impossible without crossing the organizational boundaries. As long as organizational boundaries are perceived as clear, organizations are seen as organisms and/or cybernetic system. More suitable analogies for blockchains are club, Hansa (Miscione, Klein, et al., 2019), consortium, or even tribe in more fragmented and conflicting environments (Miscione et al., 2018). From the cases above, it can be noted that a much finer granularity of border patrolling is possible. Involved parties may agree on flexible or dynamic "gates" that allow or impede participation, then put in place a policing mechanism to enforce those agreements.

Last but not least, two entangled problems relate to the redefinition of boundaries and access control:

- The dichotomy of infrastructures vs. platforms (Constantinides et al., 2018), with the former defined by wide accessibility and public interest, and the latter by multi-sided markets and profit seeking behaviors, respectively
- The prisoners' dilemmas that actors in low trust environments cope with continuously (Gambetta, 2011), and which impede the stabilization of agreements, in turn to be encoded in distributed ledgers.

External Legitimation. Blockchain technology finds its origins in the rejection of external authorities but, interestingly enough, states and other authorities are now adopting and deploying blockchains. Even if in most cases their control and power over these multi-party systems is relatively limited, when they are present, their role is not marginal, as it can be seen in the rather centralized decision-making placement in cases 1, 2, 5, and 13. Indeed, especially when the state weights in, legitimacy is outside of the consensus mechanisms inscribed and deployed by blockchains. The most evident outcome of state presence is the possibility of some sort of appeal that, contrary to the dogma of immutability (DuPont & Maurer, 2015), allows the reversion of undesirable entries or the exercising of further control, like excluding undesired actors. This centralization of decision rights, which may as a result correspond to the hierarchical ideal-type (Williamson, 1975a), raises the question of whether those prospected solutions indeed overcome core problems found nowadays in and around land registries (Goldstein & Udry, 2008; Rizzo, 2015); for example, decisions on data management as well as on reversing transactions would remain in the hands of the state or state-dependent actors (notaries). The prospected efficiency gains, however, seem widely desirable.

On the theoretical side, the unachievable self-containment of blockchains – and the consequent role of external legitimacy – calls for limiting the unfettered claims of regained agency that blockchains promise to their adopters. Blockchains, in fact, elude both internal legitimacy (acceptance based on nodes' consensus only) and external legitimacy (consensus derives from a well-defined context and its authorities). Instead, blockchains produce and rely upon a middle ground defined by the joining parties – which are not "into each other" but not external either – and their own contextual constraints.

The above implies that we have to refrain from going back to the conceptualization of context as pregiven (Winter et al., 2014). Institutionalism (North & Alt, 1990) has traditionally highlighted the formal and informal constraints that shape actions exercised by the social environment within which organizations operate. Neoinstitutionalism (Powell & DiMaggio, 1991) introduced the concept of an organizational field, which transcends organizations' immediate surroundings and comprises all organizations engaged in the same kind of activity (higher education, car manufacturing, etc.). Even though the latter concept is broader, it does not account for the diversity of contexts with which different blockchains interplay with. It is of course possible that over time, a blockchain organizational field would emerge, thus blockchains would be subject to similar pressures across the field. Whether this happens or not, all cases above illustrate how the context of reference for the blockchain emerging phenomenon is "network dependent", that is, usually disparate contexts like cryptographic software development communities, jurisdictions, landowners in emerging economies, miners, and artists, etc. are pulled together and provide novel modes of legitimacy before isomorphic pressures (DiMaggio & Powell, 1983) spread throughout the field. Thus, by understanding the scattered but newly interdependent contexts of reference, we can shed new light on if or how legitimacy is gained in global context, and, thus, how innovation may succeed or fail.

Reduction of Discretionality. Since blockchains are basically enforced consensus algorithms, ad hoc decisions (i.e., discretionality) are intended to be minimized to the early stages of rules setting. Once they are built into algorithms, human intervention ends up being reduced, to the ideal extreme of people kept "out of the loop". Despite this, enhancement, membership and off-the-chain conflict resolutions leave the door open for ad hoc decision-making. As can be seen in our case collection, conflict resolution protocols remain not in place or through real-life courts, membership is either regulated through gatekeepers or entirely open, and discussions on demand management is either enacted hierarchically (land registries), in consensus among few (supply chains), or in consensus among many (cryptocurrencies). These are all loopholes through which discretionality finds its way back in, and stands in contrast to the deterministic fashion in which smart contracts promise to function (Kitchin, 2017), which questions smart contract adoption maturity (Gatteschi et al., 2018). Thus, automatic and human decision-making appears to take place side by side, sometimes in competition, but algorithmic governance is merging with, rather than substituting, other modes of governance.

Reduction of actors' discretionality can be seen as an attempt to reduce the overall uncertainty of a system, thus, to mitigate risk. However, we should not be deterministic about this. As Perrow (2011) made clear, tightly coupled systems – like those blockchains produce to the extent that involved parties are tied together – might be riskier because of unintended consequences and cascade effects that propagate quickly across a system whose nodes are synced and where human supervision is marginalized. So, a micro-level reduction of discretionality does not necessarily exclude/mitigate uncertainty and risk at an aggregate level. The creation of tightly coupled systems with no room for discretion may, to the extreme, be a recipe for disaster.

Temporal Management. Last but not least, all blockchains provide inalterable time-stamped records. Beyond this basic feature, most cases show some sort of temporal dimension in the form of enhancements, access control of new members, and reversion of transactions, which is in line with other operational blockchains (De Filippi & Loveluck, 2016a; DuPont, 2017). As with all information systems, the analyzed blockchain cases were initially designed according to a core group's preferences (Bloomfield & Danieli, 1995), which might mismatch with later needs. This places initiators as key stakeholders exercising major influence over blockchain systems (F. Glaser, 2017; Hsieh et al., 2017). In other words, once the bootstrap problem is solved by reaching a critical mass, the same features of success in an environment may end up hampering further growth (Hanseth & Lyytinen, 2010).

All of these aspects add human dimensions to decision-making and spread human influence on blockchain systems over long periods of time. This rather long time frame could be problematic for management because this new type of system may not live, at least in its current forms, as long as the functions that it is intended to perform. This opens the problem of future transitions to new technologies (Nitto et al., 2008; Norta, 2016) and for one, it points to the formerly introduced notion of tribal behavior (Miscione et al., 2018) of users. On top of backward compatibility issues, two opposite problems arise: Lock-in effects and longevity. Both are central in relation to the immutability of records blockchains offer. Despite best intentions, anticipating long-term transformation of technologies proved impossible. Thus, it remains impossible to avoid risks of lock-in, even if open standards and architectures may mitigate these risks (Fishenden & Thompson, 2013). Needless to say, those lock-ins are acutely problematic when distributed ledgers are foundational for other activities like trades. Longevity of records may not be a paramount concern to the extent that stable and widely legitimized organizations, like states, can weigh in to certify what is needed. If certification capacity is completely reduced to hashed digital records, the unpredictability of the future and trust come together to the extent that no legitimator of last resort is available. As in tightly coupled systems, a reduction of checks and balances may increase rather than reduce uncertainty and risk.

3.7 Conclusion

This research studied blockchain systems through the lens of six decision problems emerging from blockchain governance: problems of demand management, data management, system architecture design and development, membership, ownership disputes, and transaction reversals. The first three are new instantiations of known information system research problems, thus they can be seen as 'old wine in new bottles'. The latter three sit at odd with existing concepts, so they need to be understood – 'walking in someone else's shoes' – to further information system research in this emerging field. Illustrating their enactment on empirical domains guided our understanding of how power in those cases is distributed and in which fashion (algorithmic, ad hoc, formal, informal). The findings from the application of our lens suggest four dimensions of theoretical relevance, which can be synthesized as follows:

- The redefinition of borders and tools for their patrolling marks a major difference from the bazaar mode of governance (Demil & Lecocq, 2006) without falling back onto existing conceptualizations (Powell, 1990). The blurring of the distinction between agency and context questions a basic assumption of cybernetics dating all the way back to its founder: Wiener (1948) and Beer (1966) who brought it to management studies.
- Descending from the previous, legitimacy does not come from inside or outside organizations, but is an ad hoc network-dependent arrangement produced by the parties involved, each with own context of reference. This exceeds the concept of context in Institutional theories (North & Alt, 1990; Powell & DiMaggio, 1991).
- While the reduction of discretionality, and the loathed politics, may be aimed at making the world fairer and more predictable, the cautionary tales of tightly coupled systems should raise a red flag and encourage a more critical approach to the consequences in practice of blockchain-based systems (Perrow, 2011). On the side, the design challenge of creating more loosely coupled systems while preserving some blockchain peculiarities is open.
- Timestamping and immutability are the peculiar features the blockchains bring about. As for tightly coupled systems, the theoretical challenge is in how those systems play out in practice and interact with organizations and society in relation to aspects that elude design, like long-term longevity. Here the main contribution is to studies on

information infrastructures in practice, especially: Ciborra et al. (2000), Bowker and Star (2000), Lyytinen and Hanseth (2010).

Of course, this research is not free of limitations. First and foremost, governance, whether implicit or explicit, emerges in practice and over time, and case studies can only depict snapshots at given times; hence, it would be interesting to see, in which domains blockchain technology is most adopted for one. We encourage researchers to iteratively study the governance of specific blockchain systems over time and to make conclusive statements about their evolution. Even though we paid close attention to properly shaping our lens, it does not and cannot address all peculiarities in relation to blockchain systems. Furthermore, permissioned blockchain systems in particular can be considered to be in their infancy, meaning the number of established and operational cases is still relatively limited. All things considered, our research, therefore, rather than making conclusive statements, strives to highlight and contextualize emerging problems in an exploratory manner, and propose cornerstones for further research. Our research not only answers the call for research on governance in and around blockchain systems, but also anticipates the consequences of those decisions in practice, which may also affect practitioners.

In conclusion, for further research, several things could be considered. As we argue, blockchain organizing exceeds firm boundaries and demands to define suitable modes of mutual dependency of multiple formally independent actors. Incentives constitute a possible glue between these actors and should be further studied. On the same line, besides decision problems, accountability problems could also be discussed. Even if blockchain organizing resembles to some degree the fluidity of FOSS, peculiar actor types can be derived and their roles and accountabilities described, as already initialized in early studies in this direction (Islam et al., 2019). Finally, it is worth considering whether those blockchain systems end up allowing users to have more influence on decisions, or if blockchain systems are ultimately deprived of what is automatized by consensus algorithms. One way or another, following what people put their trust in and when, is a promising way to understand blockchains in practice.

4 PAPER III: Authenticating Deeds/Organizing Society Considerations for Blockchain-Based Land Registries

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Abstract

This chapter steps back from specific empirical cases and discusses alternative theoretical lenses that can be used to study if and how blockchain-based registries in Africa will be affecting organizations and society. Those lenses are: Neoinstitutionalism, Structuration theory, and Actor-Network theory. Each of them is adopted to outline aspects of blockchain first, then to highlight specificities in Ghana, finally to suggest research lines. This plurality of theoretical lenses encourages to foster a more nuanced understanding of unconventional contexts of technology in use, thus to derive better recommendations than those based on reductionist frameworks, which often overlook specificities of developing countries.

4.1 Introduction

For years now the hype surrounding blockchain as a new and more decentralized architecture to facilitate transactions has led people to search for cases of application for this emerging technology. Before thematizing the hype that has been propelling blockchain on the global stage, it is useful to mention the main novelty that blockchain brings: authentication of uniqueness of data in digital settings or 'native authentication', i.e. without relying on an external/non-digital intermediary. Without this property, it could not be used for digital currency, which, of course, must be unforgeable. Other relevant, and related properties are: decentralization (even if no unique guarantor is often substituted by clusters of miners), immutability (records cannot be deleted), auditability (mathematically provable), and pseudonymity (via key-pair identification), according to DuPont and Maurer (2015).

Specifically regarding land administration, two salient aspects of blockchains motivate the interest for it: immutability of records, which promises to reduce corruption to make land management more responsible, and so-called smart-contracts, which can facilitate transactions involving multiple parties (Griggs et al., 2017)[11]. Since digital innovation has not produced general theories that can direct the development of new technologies in organizations and societies, the innovation process remains idiosyncratic, i.e. based on people trying out things all around the world. Here, we discuss the prospects of blockchain for land registries from different theoretically informed angles. Those theories do not aim at predicting future successes. Rather, they provide distinct lenses to highlight different aspects and prospects of this technology in practice. Those insights may turn out useful for practitioners operating in very diverse settings. Although blockchain has the features of other global technologies like the Web, our aim is to make our views sensitive to the African context and developing economies more broadly.

In developing countries, it is not uncommon to have weak and often inconsistent systems to keep track of land rights. For instance, customary land ownership may be family or clan based rather than individual, like in Western cadasters and land registers. When disasters strike, legal land registries may be lost, like it happened with the Haiti earthquake that left farmers fighting among each other. De Soto (2000), and international organizations, stress also the lost opportunity due to unregistered land, which cannot be used as collateral to grant people

[11] In a nutshell, blockchains are databases whose integrity is guaranteed by nodes. Their independence limits the possibilities of tampering with the records. More technological details are provided in the **Blockchain** section.

access to financial services. Other positive side effects of consistent land ownership registration have been put forward. For example, in Peru clear registration of land ownership reduced the racketeering that farmers were exposed to in areas where coca leaves were cultivated.

So, what are the gridlocks that obstruct the consolidation of basic tools of land management like land registries? Of course, there is no exhaustive answer to that. What is worth highlighting here is that corruption, vote of exchange, speculation, vested interests all undermine the basic agreements needed to establish a common land registry. In the domain of land registration, the promise that blockchain brings about is that of inherent immutability and transparency of the distributed ledger, which leaves less space for 'manoeuvring'. Before introducing the cornerstones of blockchain as a technology in the **Blockchain** theoretical section, we are setting the scene of this work starting with the high expectations that surround blockchains.

4.2 Setting the scene

Why blockchain and why now? Agre (2003) states that the narratives in which new technologies always come wrapped do not explain technologies themselves, but the energy that propels them into societies. Blockchain, like other information technologies, can be considered as a statement of intent towards a target audience, designed to initiate and guide action (Bekkers & Homburg, 2007). So, they can be also seen as a myth (Mosco, 2005). Myths are tales providing shared frames of reference that enable individuals, groups and organizations to deal with, or overlook, contradictions that cannot be fully resolved. From this perspective, the legitimation of blockchain applications derives from their persuasive power: whether the allure of blockchain mobilizes necessary resources from decision-makers, investors, developers, users (Miscione, 2015). Homburg and Georgiadou (2009) explored how the narrative wrapping and legitimizing of spatial data infrastructures (SDI), a previous wave of technological innovation, travelled from North America to Europe, then to other continents since the 1990s. The kind of analysis they propose is discursive: SDI are conceptualized as a myth, able to organize human action and mobilize resources independently from the hard facts, often claimed to be the foundation of those projects.

The narrative of blockchain technology is recurrent and well-crafted: it originated during a global financial crisis and was built to overcome untrusted intermediaries like states and banks. Its most well-known application, which proved its functionality, has been for Bitcoin, the first and largest crypto-currency to date. Nakamoto (2008), the unknown and mysterious author of the Bitcoin seminal paper, together with others from the same crypto-libertarian circles, gave paramount importance to decentralization to circumvent intermediaries. A provocative paper by Atzori (2015) makes this attitude clear right from his article's title: "Blockchain technology and decentralized governance: Is the state still necessary?" The hype surrounding blockchain systems seemed endless until its peak: the cryptocurrency market capitalized close to 800 billion USD in winter 2017, not counting the initiation of a plethora of projects which explored the application of blockchain technology in domains other than finance. All these prove the forces that a convincing narrative could mobilize.

Bitcoin recently had its ten-year anniversary, establishing it as the first successful, apparently independent global financial infrastructure. If Bitcoin had not increased in value so dramatically, it is very likely it would have had neither the global outreach nor the security it nowadays has. So, its hyped narrative had material, undeniable effects. One of the keys of its success is the incentive for miners to partake (1) in the distributed authentication process to seal rightful transaction – e.g. avoiding double-spending/forgery – but also (2) in the maintenance of the ledger – e.g. continuing the longest, thus most reliable, chain of transactions. However, Bitcoin's governance problems are undeniable as well. The never-ending conflicts about its block size, with consequences also on the incentives for miners, show the short-sightedness of thinking that such a financial system would organize spontaneously, without requiring governance.

Moving beyond its origin in financial applications and start-ups of all sorts, cryptocurrencies have put blockchains on the agenda of many multinational companies as well as governments and international organizations, which explore potentials of blockchain technology that would not have been tried otherwise. Land registries are one of those cases. So, the hype propelling blockchain is real, not because it predicts if this technology will be successful and for what purposes, but because it has real consequences for people and organizations trying to apply it to the most diverse domains and countries, including land administration in Africa.

Before moving our attention to three distinctive theoretically informed views on blockchain prospects for land registries, it is worth noting the common roots of De Soto's focus on land property and smart-contracts[12] as documented by DuPont (2019). De Soto started influencing the Peruvian economic system from the 80s and 90s, especially establishing land titles, which in turn helped in formalizing the Peruvian black economy, then gave impetus to economic

[12] Self-enforcing code when defined criteria are met. The term 'contract' is misleading; it rather regards encoded logic, which only in rare cases resembles contracts. Prominent use cases of smart contracts are blockchain-based crowdfunding (Initial Coin Offerings), exchange of values, auctioning, or property rights management.

development. Similar approaches were later embraced by international organizations like the International Monetary Fund and pushed to other developing countries. More recently, De Soto himself turned his attention to blockchain for land registration with a project in Georgia. In theory, pairing blockchain architecture with smart-contracts would facilitate a more dynamic economy. On the side of smart-contracts, it is remarkable to note that Szabo, a prominent figure in the crypto-libertarian scene, refers to land registration as prone to being forged if not maintained in a decentralized manner (DuPont 2019). So, the alliance of property rights and decentralized authentications are the cornerstones of his envisioned mode of organizing society.

In this chapter we do not speculate on the possible consequences of these views. The aim is to identify basic principles of and ideas behind blockchain in dialogue with essential characteristics of an empirical context (i.e. land governance in Ghana) through the use of different theoretical lenses. The final aim is then to distil future research directions and questions that are both empirically relevant and theoretically informed.

The structure of this paper reflects its theoretical foci and continues as follows: three theoretical angles are used to shed lights on different prospects of blockchain for land registries in Ghana and countries with comparable land governance in Africa. Those theoretical cornerstones are: Neoinstitutionalism, Structuration Theory, and Actor-Network Theory. After a brief introduction to each theoretical lens, each of them is considered sequentially in relation to: 1) blockchain technology, 2) Ghana's land governance context, 3) prospects for further research.

4.3 Theoretical angle: Neoinstitutionalism

North (1990) defines institutions as the formal and informal rules that shape social interactions. In other words, they are akin to the rules of a game. In terms of Neoinstitutional theory, institutions are defined as accepted social models informing human behavior. Institutional theory, compared to Structuration theory or Actor-Network Theory, is less sensitive to action, and emphasizes more the social models that explain and constrain patterns of individual and collective action. Neoinstitutionalism, especially Powell and DiMaggio (1991) introduced the concept of organizational field to draw a boundary around organizations engaged in the same kind of activities (e.g. projects for registering land in our case). Within a field, it is common to observe the phenomena of isomorphism, even when rational choice models would predict differentiation processes based on outcome maximization efforts. Although institutions are often mentioned in research on land registries, actual use of institutional theory is quite rare in a field that is more sensitive to envisioned developments than to persistence, for an example of such work see de Vries, Bennett, and Zevenbergen (2015).

From the cognate domain of SDI, Silva (2007) discusses how institutionalization of technology does not occur by decree. For a case of a land administration system in a Central American country, he highlights and discusses the institutional constraints for roll-out of a spatial information system. His qualitative study describes in detail the diverging approaches of the locals and information system promoters regarding the rationality of institutions, the link between the information system and work tasks, and historical resistance to change in the institutions that regulate land ownership. Prominently from this account, one sees how interorganizational cooperation is not created by an information system, rather it is a condition for the roll-out of the system.

To explain and manage blockchains for land registration in diverse settings like Ghana and other African countries, Neoinstitutional theory has two strengths. First, it can account for a variety of groups, across which technology use spans. Second, Neoinstitutionalism has a peculiar explanatory capacity for phenomena that happen within an organizational field even when no direct interaction between people in that field takes place. For example, different countries opt for similar modes of land registration under the pressures of imitation rather than independent analyses. Indeed, isomorphism is already detectable to the extent that the idea of using blockchain in land registration was embraced by international organizations, tested in Georgia, and now tried out elsewhere across the same organizational field.

4.3.1 Blockchain

It is important to highlight some fundamental characteristics of blockchains to figure out how they may relate to land administration in a variety of institutional settings. Peters and Panayi (2015) classify blockchain systems along (1) whether the access to transactions is public (for everyone to see) or private (for selected parties only) and (2) whether validation of transactions is permissionless (any participating party can validate transactions) or permissioned (selected parties validate transactions), as summarized in the following table. The parties are called "nodes" in a blockchain system.

	Access to Transaction Validation		
Acc		*Permissioned*	*Permissionless*

	Public	All nodes can read/submit transactions; authorized nodes validate transactions.	All nodes can read, submit, and validate transactions.
	Private	Only authorized nodes can read, submit, and validate transactions.	N/A

Table 20. Classification of Blockchain Types, adapted from Peters and Panayi (2015)

Consider Bitcoin, the best known and widely spread blockchain system to date. Bitcoin has been initiated at the same time as the beginning of the 2008 financial crisis as a system sidelining the centralization of power and avoiding external influence, such as corrupted and untrustworthy intermediaries. This is constitutive of its design: relating to the above table, Bitcoin's transactions are publicly accessible, and every party can partake in transaction validation by providing their computational power. From a user's perspective, money transfers via Bitcoin can be faster and cheaper, especially when international payments are considered.

What differentiates blockchain systems from previous systems for land registration is the provision of uniqueness of data (native authentication) without relying on any guarantor who mediate transactions. Technically, the blockchain can reliably keep record of transactions without having to rely on cadasters and/or notary services. Of course, those transactions may not have legal standing, but at the very least they can mathematically prove each transaction that occurred. So, blockchain systems rely on decentralization (no unique guarantor), immutability (records cannot be tampered nor deleted), auditability (mathematically provable), and pseudonymity (via key-pair identification) (Maurer and DuPont 2015). It is important to stress that blockchains themselves do not guarantee land data quality, which depends on who enters them, but only data immutability. Nonetheless, the persistence of data may act as a deterrent from entering false data because fraudulent entries can be traced back and not deleted.

From an institutional perspective, land management through a blockchain system is peculiar for many reasons. For one, the intermediary's function is thereby substituted by distributed consensus maintenance (mining), introducing rivalry in digital settings (Ziolkowski, Miscione, and Schwabe 2018): Validating parties thereby compete for a reward in finding the next block by solving a complex mathematical puzzle, which is labelled as the consensus algorithm. In short, Bitcoin's immutability rests on computational power: as long as 51% of the hashing capacity[13] remains honest (complies with the code), the system continues to work as expected. The quantity of computational power devoted to the consensus algorithm and its related rewarding scheme, hence, correlates with system security.

For two, considering Bitcoin again, the rules for the system to work were formulated and enacted early on by its initiator (Nakamoto 2008). While changes to the system are possible, with varying impact levels (soft- vs. hard forks), every change requires consensus among the majority of nodes and parties. More than with free and opensource software (FOSS), every change of a software's functionality may leave those who favored the previous version behind (no backward compatibility). Something similar happened to Bitcoin and also to other blockchain systems. The history of disagreement (ending up in forks) within the Bitcoin community is well-documented (De Filippi & Loveluck, 2016a). Forks have endangered a system which capitalizes hundreds of billions USD at its peak (Campbell-Verduyn, 2017), and show to researchers and practitioners the consequences of the collision of incompatible social models and values hard-coded into IT.

4.3.2 Specificities in Ghana: Institutional plurality and the plurality of documentation

As in many African countries, land governance in Ghana is characterized by fluid boundaries between formal and informal institutions (Benjaminsen & Lund, 2002; Herdt & SARDAN, 2015; Hyden, 2005; Olivier de Sardan, 2015) and a plurality of norms and laws that govern land access, uses and transfers. The Land Administration Project of the World Bank (2003-2008) consolidated various organizations under the Lands Commission (LC) and created the Customary Land Secretariats (CLS) with the aim "to help customary authorities to improve and develop customary land administration" (Arko-Adjei, 2011, p. 81). The LC holds the mandate to register land rights and maintain land tenure records as per statutory law. The customary sector includes the chieftaincy institution, namely the "stool" chieftaincy in the south and the "skin" chieftaincy in the north, the latter being accompanied in customary offices by earth priests in some northern regions (Lund, 2008). Many of the statutory laws concerning land rights and associated administrative agencies originated in the time of Ghana's independence. The overall move towards formalization of land administration across various types of land sectors (Oberdorf, 2017) plays a role in defining the institutional

[13] Sum of computational power of all validating nodes at a given time. Solving the mathematical puzzle relies on searching for the right 'hash'. This process is hereby referred to as 'hashing'.

landscape around land rights documentation; and various types of institutions and associations may vie for recognition as public authorities. In so far, we can speak of a kind of isomorphism that follows the insignia of the state, an isomorphism where formal norms (de Sardan 2015) carry across different organizations and associations of actors and practices. At the same time, the "plurality of institutions produces … ambiguous practical meanings of law and property" (Lund 2008), p. 6). Procedures and practices of land rights registration are not uniform across the country, but involve different actors and different proofs of evidence in the chain of validation that lead to an eventual registration, mostly of leasehold titles, with the Lands Commission (Abubakari et al., 2018). In sum, despite isomorphic trends towards formalization and uniformization of registration processes, the institutional plurality and local politics over land produce a plurality also in methods to establish what counts as evidence for land claims with (contesting) oral knowledge and witness accounts playing an important role in land claim making processes (Berry, 2000). In conclusion, even if the original values of blockchain and Ghana land registrations are unrelated, they might still converge in as far as the lack of a unique intermediary authority can be circumvented by an inalterable record of transactions which can allow unrelated parties to trade.

4.3.3 Theoretical highlights and possible research questions

Institutional theory in any of its variations considers especially the legitimate social models, thus the socially accepted courses of action that people have in front of them when dealing with the many aspects of land management and use. As it is strikingly clear from the previous two sections, blockchain mode of organizing and land registration in Ghana show little to no overlapping. However, two considerations may avoid discouragement: firstly, the origins of technology do not exhaustively predict where it ends up. The internet was invented to reduce the consequences of a Soviet nuclear attack on the US (Abbate, 2000) and ended being used to share pictures of cats and vacations. Secondly, even if the institutional logics remained different, there is no reason to exclude a priori that different logics could coexist side by side. For example, even if nuclear power came from military purposes, and is still managed in a highly hierarchical way, it serves civilian purposes no less.

So, we should not get carried away by an overemphasis on decentralized vs. centralized registrations and different courses of actions that Institutionalism highlights. The assessment of blockchain for land management should not be based on the fit between blockchain consensus and "statutory institutions" or "customary institutions." Rather, what is likely to happen is that different systems (paper based, oral, blockchain-signed…) will be interplaying with each other. Institutional theory invites to transcend the idiosyncrasies of individuals and consider social models to manage these interplays. With these points in mind, institutional theory can prompt further action and research on blockchain and land registries by focusing on these central concepts: immutability, auditability, incentive scheme, legal system vs. 'code is law'. Immutability over long periods of time is obviously central for any reliable land registry. Uncertain longevity of records undermines their validity from their inception. Immutability is also the core of blockchain technology, which relies on it to diminish the influence of third parties. Thus, to the extend third parties are a threat to records (corrupted officials, speculation…), blockchain and land registries can converge in practice. Still, the actual longevity of decentralized authenticated tokens[14] over decades has to be proved. Also, their legal standing in courts awaits for confirmation.

Accordingly, research questions could be: Which land management practices would embrace or avoid blockchain-based registries; and for what reasons? Then, which existing authorities would gain or lose from the progressive introduction of those records? Finally, would the institutional landscape in Ghana see an increase or decrease of competing land registration practices?

Partly descending from immutability, auditability (allowing reading rights to non-validating parties, e. g. not-mining users) holds some promise of streamlining land management because it makes easier to check who did what and when.

Moving to the more technical aspects of blockchain, an innovation that proved viable at scale is its incentive scheme that keeps actors compliant with a consensus algorithm set up a priori. Ideally, this makes it conceivable to move away from current cost recovery strategies (fees, general taxation, etc.) and hard-code the incentives into the blockchain ledger itself. How to do that, would be a design research question with specific answers in specific contexts.

Lastly, institutionalism considers the legal system as one of the regulatory forces that shape organizations. Famously, Lessig (1999) stated that 'code is law'. Therefore, code, especially if paired with suitable incentive systems, can help to enforce law or, alternatively, to consolidate the legal system in Ghana or elsewhere. More on this line of thinking is at the end of the next section.

Empirically, Institutionalism invites to collect data where different social models encounter. An obvious starting point for such inquiry is the existing registration procedures. Another one

[14] A digital, intangible, unique representation of *something* such as a cryptocurrency. Native to a blockchain system.

is in statutory and/or customary courts, where disputes are to be settled. Also, the definition of the consensus algorithm should not be overlooked when studying land registration, because its regulatory function is likely to be far reaching, due to the immutability it enforces.

Institutional approaches have been criticized for treating people as ‘cultural dopes’ (i.e. defined by their circumstances). So, beside the prospects presented so far, it is useful to consider other theoretical angles that help where Institutionalism runs the risk of downplaying human agency.

4.4 Theoretical angle: Structuration Theory

Orlikowski (2000) is usually associated with the translation of Structuration theory into information system research (see also Orlikowski and Barley (2001). This stance, which moves the traditional dichotomy between structures and agencies to an analytical (rather than empirical) level, can help in understanding if and how a land management system reproduces existing structures by facilitating established courses of action, or, reversely, if and how new patterns of action become possible. Conceptualizing technology in use as a process of enactment opens up a better understanding of how practices change technology through its adoption.

Puri (2006), relying on Orlikowski and Gash (1994), concept of technological frames as sense-making devices, puts stakeholders’ frames at the center of attention. Puri argues that an overemphasis on technological and economic resources tends to overlook organizational and institutional dimensions. With the intention of accounting for the relation between structures and agencies, the case of the Indian National SDI is depicted through the variety of stakeholders’ perspectives, with a specific emphasis on the implementation side. The account provides a rich picture of how SDI is socially constructed, also in cases of failure. For example, he reports an excerpt of the design/reality gap from an interview with a public officer and SDI expected user:

> *We have no idea what NSDI is all about! No one has consulted us. Probably, like in the past, they [scientific institutions concerned] would design something inappropriate to our needs, and then we would be asked to use it effectively. This has been going on. I am not sure how large volumes would be accessible online given the rather poor status of data communication infrastructure outside metros. (Puri 2006)*

Structuration theory is a relevant lens to look at blockchain and land registries, because it allows to see how social structures are reproduced, and how they may harmonize or clash when they enter in interplay with new land registries. Symmetrically, this theoretical stance is sensitive to how agencies may change social structures.

4.4.1 Blockchain

Bitcoin served as a glaring example of the risks blockchain systems would face without functioning governance modes, at least when the need arises. For instance, never-ending conflicts about block size made evident that technical consensus about transactions does not suffice to regulate the whole network. Organizational consensus is necessary to avoid forks when disputes cannot be reconciled. A first attempt to formalize organizational consensus 'on-chain' has been carried out by TheDAO (DuPont 2017). A DAO (decentralized autonomous organization) aims to predefine its operation in code, thus, code becomes the equivalent of law, allegedly. TheDAO, while generating a great deal of enthusiasm and mobilizing hundreds of millions USD in funding, became a victim of its own code-is-law dogma when an alleged hacker stole part of its funds through a bug in TheDAO software (Siegel, 2016). The TheDAO community found itself in a dilemma: preserving the dogma of immutability, hence losing the funds in question, or creating a precedent by reversing the transaction, thus breaking the dogma of immutability. After heated debates, the TheDAO community, also influenced by the leading figure Vitalik Buterin, opted for the latter, forking the underlying Ethereum blockchain while leaving the dissidents continue running the original chain, which is currently called Ethereum Classic.

From an agent-structure perspective, 'code is law' entails agent's adherence to whatever outcome is predefined by the code, which keeps the interplay between the agent and structure constricted; the agent's influence on the structure, hence, is supposed to end after the design and development phase. As it became apparent to Bitcoin and even more with TheDAO, this line of thinking (which assumes the possibility of complete/self-contained contracts) cannot handle unforeseen circumstances. Thus, there must be a means for rules to change the rules, as one cannot anticipate the unknown. 'Code is law', hence, can turn into 'Code is Constitution', i.e. rules to change the rules. And, in fact, this is what happened in more recent developments: in the time that followed, on-chain governance gained in importance with large, and heavily-funded projects such as Tezos (Crunchbase, 2019b), Aragon (Cuende, 2017), D-finity (Crunchbase, 2019a). These aim to preserve the benefits of immutability while allowing for changes to the system upon consensus; and by that, facilitating the interplay between agents and structures in front of unknown circumstances.

4.4.2 Specificities in Ghana: structures of opportunity and strategic documentation

At a simplified level, the diverse geography of land documentation and recordation in Ghana derives from the dynamic tension between two forces: the force towards an ideal Weberian type state structure to govern Ghana, on one hand, and the forces of decentralization and fragmentation driven by the "politico-legal institutions that compete for political authority [and which] operate to legitimize their undertakings partly through territorial strategies" (Lund, 2013, p. 16). This dynamic gives rise not only to legal stipulations for the registration of land rights to be implemented variously across the country (Abubakari, Richter, and Zevenbergen 2018), but also provides what Lund (2008, p. 4) calls "structures of opportunity for the negotiation of rights and distribution of resources." For example, in decision making over land uses and transfers individuals and groups of agents may act as what Moore (2000) refers to as semiautonomous fields drawing on different rationales to legitimize claims to land. The choices and decisions to document land claims as a land right (of whichever nature this may be) is contingent upon the anticipated effects of documentation on social and economic positions of individuals and groups. Berry's work (2001) in the southern Asante region of Ghana, for instance, illustrates that claims to land are made and legitimized through processes of re-narration and revisions of constructed histories of people-land relations. Thus, while land itself may form the immutable entity that provides family or clan lineages' identities through time, the documentation of land may be used to break with, reshuffle or comply with customary social structures depending on circumstance, need and aims. The overall outcome then of a given process of negotiation and contestation may be likened to the consensus building in Blockchain systems in so far as there is no central node with final verification and legitimation power. However, in Ghana this production of records does not run according to programmable, mathematical rules, but entails political contestations and differs according to problem context. Neither is law law, nor is code law. What is strategically and politically deployed is the "mutability of records."

4.4.3 Theoretical highlights and possible research questions

Also in this case, a common theoretical angle does not hide the wide differences of structuration processes in relation to blockchain on the one hand, and Ghanaian land registries on the other. Nonetheless, some common central concepts can again help us in action and research: the shift from 'code is law' to 'code is constitution' is a salient one. Since algorithms – it does not matter how sophisticated – do not always achieve to put on track the unpredictable future, consensus building has to move one level down: rather than rules (i.e. structures) to regulate people (i.e. agents), the consensus needs to be about how to change rules when the need arises. The clear analogy here is to constitutional laws that regulate how laws can be changed. This can be seen as the product of tensions between structures and agencies. Indeed, since agencies and structures cannot be always reconciled, the need to have a higher level of appeal may arise.

In relation to land registries in Ghana, this theoretical angle highlights the misalignment and frictions between rules and actors. When operationalizing Structuration theory into a concrete research design, it can be useful to keep in mind that rules/actors does not necessarily correspond to algorithms/people. Rules can be humans and actors can be software agents, especially in the context of on-chain governance, which intends to enable DAOs.[15]

Another recommendation for further action and research about blockchain and governance is to consider that, contrary to previous IT architectures, blockchain are relatively inflexible because of their promise to guarantee immutability. Therefore, consortia designing and developing blockchain based land registries have to agree quite precisely on details of how their registry is going to work early on in the process. Later changes risk to undermine the credibility of the whole record, or at least to generate inconsistencies (Ziolkowski, Miscione, and Schwabe 2018).

Finally, an interesting terrain for practitioners and researchers is to figure out if and how it is possible to design incentive schemes that make this distributed ledger scalable and self-sustainable. Indeed, making the unknowns known would certainly help in figuring out how to balance what goes into the code and what remains matter of people's discretion.

Possible research questions are: if the overall scene is one of validation of evidence as instrument in politics, how would blockchains play out in this context? Whose agency would they support in Ghana? What new structures would they create or which structures would they legitimize?

[15] In principle, land governance actors in Ghana could be receptive to Blockchain conceived of as another form of database to legitimize something existing (e.g. statutory or a chieftaincy's), but they would be reluctant regarding the immutability trait of blockchain. Quite likely, they would seek to build in what happened in TheDAO's case: rules to change the rules. Then, the question is: what form would such constitution take in an instance of implementation in Ghana? Would it embed practical norms implicitly? Who be the author of such blockchain constitution?

Despite its strengths, Structuration Theory tends to be weak in accounting for difference and radical transformations, as both of them are not necessarily produced by incremental change. The last section on Actor-Network Theory may help in that direction.

4.5 Theoretical angle: Emphasis on actors and objects

Related to the direct and indirect influence of actor-network theory (ANT), actors, artefacts and objects have been coming to the foreground in a number of disciplines. The concept of boundary object was first introduced by Star and Griesemer (1989) to explain the case of the foundation of a museum, which was possible, because different stakeholders did not need to negotiate a common understanding about the museum, nor common goals. Rather, it was enough for each of them to act according to their own social world; the boundary object was, at the same time, the product of those actions and the mediator across them. The basic idea of boundary objects has been developed and specified in several directions: for instance, intermediary objects (Boujut & Blanco, 2003) and boundary negotiating artefacts (Lee, 2007) emphasize different stages of evolution of a boundary object during product development. Bechky (2003) relates boundary objects with the boundary between professional belonging and status.

Harvey and Chrisman (1998) introduced the concept of boundary object in the geographic community by arguing how geographic information systems (GIS) act as boundary objects through mediating between different groups who do not share common understandings. Through a microscale study on GIS and wetlands, they show how it worked despite 'wetland' having different meanings for different actors: "The agreement is only paper-thin. The boundary object serves to solve jurisdictional and administrative battles while it conceals continued geographic ambiguity" Harvey and Chrisman (1998). Harvey (2006) discusses the necessarily elastic relation between the cadaster and land tenure in Poland. Local practices, also inherited over generations, have to find working accommodations to relate to Polish state and European Union regulations. Hence, this information infrastructure is tense between diverging civil and political interests. So, it acts as a historically grounded boundary object.

This kind of objects are a suitable sense-making device to approach land registries and blockchain when the points of convergence between stakeholders are a determinant aspect to account for. For instance, when a land registry spans across areas regulated by different property regimes, conceptualizing a registry as a boundary object highlights how commonalities and differences converge on a possible solution.

4.5.1 Blockchain

Many of the public and permissionless blockchains (Bitcoin included) have publicly available source code, free for everyone to fork and to set up one's own blockchain. This is similar to FOSS projects such as Linux or Firefox, whose mode of governance has been labeled 'bazaar' by Raymond (1999) and Demil and Lecocq (2006): this mode of governance is characterized by openness and fairness, and an open license contract of the object in question. Further, there are fairly limited ways to exercise control over actors (to use a particular version of software), and an actors' motivation to contribute with new code is rather low unless reputation is pivotal.

According to Miscione et al. (2018), blockchains differ from FOSS in many ways: blockchains bring rivalry among actors, e.g. a token always belongs to one entity at a time; their value is rooted in their uniqueness. Having conflicting versions of token ownership would undermine the ledger's integrity and by that affect the token's value. Forks are undesirable, because users of a blockchain have a mutually dependent interest in the integrity of data, which, in contrast to the 'bazaar', leads to a stronger common interest. What's more, if a majority of actors running a particular blockchain instantiation changes its consensus mechanisms, this change can be enforced on other users, which is not a feature of FOSS.

Comparing FOSS and blockchain systems with an emphasis on artefacts offers two perspectives. FOSS can certainly be seen as a boundary object, where communities of actors with widely diverging interests contribute a variety of solutions; however, there is common ground with every release, patch, or update of a software. The elasticity of FOSS is well exemplified in one's low switching costs from one version to another, so an arbitrary version (even a self-programmed version) of software can be instantiated upon one's liking. Does the same apply for blockchain systems? Even if a blockchain system can be seen as the result of a sense-making process across different actors or groups, likely with diverging interests, the elasticity of a blockchain system is far more constrained: blockchain systems are defined by the consensus protocol, which determines everyone's mode of participation.

4.5.2 Specificities in Ghana: land rights documents and fees as boundary objects

Within the context of land governance, land itself forms an important boundary object, across which different communities and institutions associate and disassociate (not seldom violently). While land creates boundaries through various modes of exclusion, it also forms the object around which "webs of interests" develop and sustain (see e.g. Meinzen-Dick & Mwangi (2009)) through a variety of uses with corresponding bundles of land rights (Davy, 2018). Within this context, technologies to support or change processes of land documentation and recordation also function as boundary objects. The socio-technological assemblages include not only the survey equipment of certified land surveyors or the GPS enabled mobile phones of "fit-for-purpose mappers" (Lengoiboni et al., 2019), but also the digital data, the land rights documents that are being printed and issued to landholders as well as the associated fees for various signatures and stamps on a series of documents that come to verify a land claim or transaction. The associations of actors that emerge through time may stabilize into larger actors that endow the process with legitimacy and at the same time bind together people, who previously held different meanings regarding land, property and documents themselves. For example, in the process of leasehold registration, we see that the technologies and templates for formal recording of the Lands Commission (LC) form boundary objects that negotiate with LC external processes and actors. In this meeting meanings and norms of the bureaucratic arena become adjusted in response to social norms and administration external actors, which in turn also change. What emerges is a space of "practical norms" that can be quite literally visited and observed at the encounters between registrants, intermediaries, and officials in front of the Customer Service Access Units of the LC (Abubakari, Richter, and Zevenbergen 2018). Fees paid for a variety of intermediary documents, services and signatures constitute an important, if not constitutive, element in the creation of such networks across differing institutional contexts. Meridia, a for-profit organization that recently entered the market of land rights documentation in Ghana, actually flipped the logic in so far as it created different "documentation packages" according to the actors that need to be involved given the institutional scene that they encountered (Salifu, 2018). The latter in turn shape the content and format of a given type of documentation package, and the fees associated with various signatories create the glue in the emergence of action nets.

The examples above indicate that Ghana's context of institutional plurality is likely to give space to a new system; and it is imaginable that blockchain proponents alongside their technology may come to act as boundary objects in the emergence of new actor networks with their own normative frameworks and new shared meanings of land, property and related recording technology. However, in so far as such endeavors would succeed amidst the contestations over legitimacy, the question as to whose claims are valid for entering on the blockchain's own sphere of "code as law" and, as recent controversies over block sizes have shown, “lawlessness of code,” remains open. As such, it is as much a question of data governance as it is of land governance.

4.5.3 Theoretical highlights and possible research questions

Land rights documents in Ghana, generally speaking, played at least two important roles that evidence their value as boundary objects. First, for the purpose of enrolment of communities, initiatives to map land rights are able to attract interest especially in communities, where demand for (some kind of) land rights documents exists, e.g. as part of specific development projects, such as service provision, see for instance Lengoiboni, Richter, and Zevenbergen (2019). Second, the production of documents and decisions on their form and content enroll further actors, for example customary authorities, who sign in return for negotiated fees, and statutory actors to sanction the content of the documents. This kind of multi-party relation is well-exemplified by Meridia’s initiative. In this case partially overlapping actor networks emerge in conjunction with the development of a whole set of so called “documentation packages” for different purposes and regions (Salifu 2018).

Actors entering the land governance scene of Ghana, often recognize the central role that the maintenance of digital land rights data plays in becoming “inevitable partners” (Oberdorf 2017). In this sense, analogue or digital documents, play a similar function as both boundary objects, but also as devices in the processes of interessment, enrolment and mobilization (Callon, 1984). In a study on blockchain implementation in Ghana by BitLand and Benben, Oberdorf (2017) observed that “although not the core of the functioning of the Blockchain, the process of digitization repeatedly returned in the interviews with the companies and public actors” (p. 44) indicating both the hopes that blockchain can make documents in their digital form indisputable as well as searchable, and indicating the greatest perceived risks: the moment of entry of a document into the database and who should be the “single party” to add the initial data (Oberdorf 2017). So, data quality and immutability are properties that offer affordance for blockchains acting as boundary objects across traditional and statutory regulations. Moving to more empirical entry points and question, what an emphasis of artefacts suggest to ask is, if and how blockchain is actually used in Ghana, for what functions exactly and at what scale; and what actors and associated normative frameworks become enrolled in the process? How is it different from what we see elsewhere, and why, for instance what specific forms and uses of blockchain may function as boundary objects and what changes in meaning would we see then at the cross-roads of different normative frameworks in land governance? If stabilizing into actor networks, how would these new patterns of action interplay over legitimacy with others; and to what outcome?

Theoretical angle	Blockchain	Specificities in Ghana	Theoretical highlights and possible research questions
Institutionalism: commonly accepted social models shape courses of action and legitimize them Neoinstitutionalism: the institutional field (comprising actors engaged in the same kind of activity) tends towards isomorphism	Originally, the distributed consensus that is at the foundation of blockchain as an architecture was intended to avoid existing social models and organizations. Algorithmically certified consensus, sealed by miners, substitutes other norms and modes of regulation. BC ensures honesty in the narrow sense of compliance with the incentive scheme.	Plurality of institutions entail differentiated processes and procedures for recording and non-recording of land rights and transfers. Isomorphism is evident especially in processes of formalization of land governance institutions.	Highlight: theory invites to transcend the idiosyncrasies of individuals and consider social models to explain and manage the interplays of different systems (paper, oral, BC-signed, etc.) Questions:: - where do/would different institutions encounter the registration court cases later on, in the definition of the consensus algorithm? Which existing authorities would gain or lose from the progressive introduction of those records; and would the institutional landscape see an increase or decrease of competing land registration practices? Design research question: How to do move from current cost recovery strategies (fees, general taxation, etc.) and hard-code the incentives into the blockchain ledger itself ? Theoretical pre-caution: avoid treating people as ‘cultural dopes’ (i.e. defined by their circumstances).

Structuration: agents and structures are in constant interplay and tend to align over time.	Most BCers, and the sector as a whole, have realized that a too inflexible system does not work well when adjustments are needed due to unforeseeable circumstances (e.g. BTC size, DAO…) On-chain governance (rules to change the rules / "Code is constitution") may fit better the constant interplay between agents and structures	Administrative structures provide opportunities for strategic documentation practices and over time the emergence of "practical norms" at the interface of social and bureaucratic norms.	Highlight: theory highlights the misalignment and frictions between rules and actors. Questions: Are consortia adopting or at least considering on-chain governance? If so, how concretely and for what? Whose agency would BC based registries support in Ghana; and what new structures would they create or which structures would they legitimize? What is kept out of agents' reach (in fixed structures)? Design research questions: If and how it is possible to design incentive schemes that make a distributed ledger scalable and self-sustainable. How to agree quite precisely on details of the registry's functioning early on in the process to avoid later changes to undermine the credibility of the whole record? Theoretical pre-caution: keep in mind that rules/actors does not necessarily correspond to algorithms/people.

ANT/objects/sociomateriality: emphasis on how human and non-human actors perform together. The distinction is not explanatory, better to focus on what those 'actants' do and cannot be done otherwise	BC generated its own form of sociality that is not captured by Bazaar, etc.	Land right documents (on paper and digital data) and related technologies function as boundary objects across initiatives to document land rights and associating actors from different institutional settings creating ANTs tied into a "fee economy" that surrounds documents.	Highlight: approach shifts emphasis on artefacts and how they negotiate the boundaries between different norms, meanings, and methods. Questions (also for design research): If and how blockchain is actually used in Ghana, for what functions exactly and at what scale; and what actors and associated normative frameworks become enrolled in the process? How is it different from what we see elsewhere, and why, for instance what specific forms and uses of blockchain may function as boundary objects and what changes in meaning would we see then at the cross-roads of different normative frameworks in land governance? If stabilizing into actor networks, how would new patterns of action interplay with others; and to what outcome, e.g. legitimacy gains/losses? Theoretical precaution: avoid overemphasizing the possibilities of 'becoming' and downplaying the constraints people and organizations live by?

Table 21. Overview on applied theoretical lenses, blockchain technology, specificities in Ghana, and theoretical highlights

4.6 Conclusions

Henssen (2010) outlines a set of generic legal principles underlying reliable land registration systems, namely the booking or register principle, the consent principle, the principle of publicity, and the principle of speciality. These principles also inform recent discussions and research on the potentials of blockchain based land registries (e.g. Vos (2017); Griggs et al. (2017). Since only the principle of publicity interplays directly with blockchain, one may hurriedly conclude that land registration and blockchains are unrelated. Any of the three theorical stances discussed above helps in avoiding such a shortcut. Technology and its encounter with practices cannot be deduced from principles without well-documented risks of gross reductionism. So, empirical work cannot be supplanted by logical reasoning, but fostered by a suitable theoretical angle. The same applies to predictions of how the three main cadastral processes – e.g. adjudication of land rights, land transfer and subdivision/consolidation (Zevenbergen, 2021) – would be affected by blockchain. For example, to be considered as legally binding, transactions must take place in an unambiguously identifiable manner. Pseudonymity of blockchains may rule this out. We claim that unintended consequences are important, for example traceability of pseudonyms may have side effects, thus are worth proper consideration. Still, it is important to bear in mind that blockchain does not validate data quality (from traders, surveyors, notaries, etc.) but only its immutability. Data quality is beyond blockchain, which has no native connection to real world assets. Rather, it crystalizes the 'garbage in, garbage out'... Its only effect can be deterrence: people may think twice before entering wrong data, because they are traceable as never before.

Looking at the dictionary, 'deed' has two quite distinct meanings: "something that is done, performed, or accomplished; an act" and, in the vocabulary of law it is "a writing or document executed under seal and delivered to effect a conveyance, especially of real estate." These two meanings of 'deed' get exceptionally closer in the context of blockchain for land registries in Ghana, where statuary regulation is minoritarian and both customary regulation and blockchain derive their authority of authenticating from continued performance (or tribal ties and mining, respectively) rather than legal principles.

Some have tried to outline the state of the art in relation to land property and blockchain (for example Graglia and Mellon (2018) and Vos (2017). The challenges in front of practice and research are remarkable, and impossible to list here. So, we limit ourselves to the key issues:

- Relevance of transparency and immutability in low trust settings

- Longevity of records
- Cross-jurisdictional issues
- Disjunction between quality of data entry and immutability
- Role of state authorities in data quality and legal standing
- Prospects for multi-chain records to leverage different properties of different chains
- Effects of increased visibility of records on bureaucratic functioning (role or auditors and civil society.

While it is certainly possible that some of the expectations from blockchain for land management are tall tales (Bennett et al., 2019), we think that the three theoretical angles discussed above offer a toolkit to approach challenges of research and practice of land registries and blockchain. None of them is exhaustive, none of them can provide an ultimate guide to action and research in this domain. However, those quite distinctive theoretical views promise to account for the challenges and prospects of designing and implementing blockchain-based land registries in Ghana and beyond, especially where no one single regulatory regime is dominant.

Even though early stages of this application domain prevented us from relying on sound empirical materials, existing studies (Pelizza & Kuhlmann, 2017; Ziolkowski et al., 2018, 2019) and our initial explorations made apparent that, while blockchains strove to substitute human discretion with algorithmic authentication, humans and blockchains are more likely to re-adjust the division of labor. The outcomes of those adjustments may have far reaching consequences in terms of 'smart' land management, to the extend the rigidities of 'code is law' allow for automations that would be impossible otherwise. On the side of 'responsible' land management, technology by itself has little ethical agency. Nonetheless, the functioning of blockchains and distributed and transparent mode of authentication hold the promise of a greater accountability even thou, it has to be stressed, the lack of authorities in charge may turn up sour when problems arise.

Part II: Building Cardossier’s Governance

5 PAPER IV: Management, Governance and Value Creation in a Blockchain Consortium

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Abstract

In recent years, an increasing number of blockchain consortia have emerged. However, little is known about how these consortia are developed and what tensions emerge in such collaborations. We describe the evolution of the cardossier blockchain consortium in Switzerland, which is building a system for managing car data and seeking to improve collaboration between players in the car-related ecosystem. From our involvement with the cardossier project, we have gained insights that will be valuable for enterprises considering whether to join a blockchain consortium.[16]

Acknowledgments

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[16] Carsten Sørensen is the accepting senior editor for this article.

extensive and very helpful feedback that helped us significantly during the preparation of this article.

5.1 Blockchain Consortia are a New Type of Inter-organizational Collaboration

In recent years, an increasing number of blockchain consortia have emerged. They have become popular with enterprises that want to leverage the potential of blockchain technology and extract real business value from it. Among executives who are aware of the capabilities blockchain technology offers, *"18 percent already participate in a consortium, 45 percent are likely to join one, and 14 percent are considering forming one."*[17] Although there are different organizational forms in which businesses explore the potential offered by blockchain technology (e.g., a startup, a traditional enterprise, a consortium[18]), blockchain consortia represent a new type of inter-organizational collaboration for exploring the technology, assessing its capabilities and developing digital ecosystems and platforms to solve shared business problems.

The media frequently reports on new inter-organizational collaborations that use the capabilities of blockchain technology and reinvent industries. However, many aspects of these collaborations remain out of sight. Little is known about how blockchain consortia are formed, what role each consortium member plays, what challenges members face in collaborating and what aspects a digital transformation leader should consider when deciding whether to join a blockchain consortium.

In this article, we provide insights gained from our participation in the cardossier[19] project, which is developing a blockchain solution and consortium for sharing data relating to cars. The aim of cardossier is to manage the lifecycle of a car and thus improve collaboration between garages, insurers, state agencies and other players in the used-car market. Based on our active involvement with the cardossier project over a three-year period, we provide a rich description of the consortium. We identify six tensions the consortium faced within three major areas (consortium management, business value and governance) and describe the way

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[17] Gratzke, P., Schatsky, D. and Piscini, E. *Banding together for blockchain: Does it make sense for your company to join a consortium?* Deloitte Insights, August 16, 2017, available at https://www2.deloitte.com/insights/us/en/focus/signals-for-strategists/emergence-of-blockchain-consortia.html.

[18] Lacity, M. C. "Addressing Key Challenges to Making Enterprise Blockchain Applications a Reality," *MIS Quarterly Executive* (17:3), September 2018, pp. 201-222.

[19] The word "cardossier" is derived from "digital car data." For information about the cardossier project, see www.cardossier.ch.

these tensions were resolved. The insights we gained will help organizations to benefit from collaborating in a blockchain consortium.

5.2 The Growth and Diversity of Blockchain Consortia

According to Wikipedia, a consortium is *"an association of two or more individuals, businesses, organizations or governments (or any combination of these entities) with the objective of participating in a common activity or pooling their resources for achieving a common goal."* A consortium is a traditional form of cooperation between institutions that see value in sharing resources and know-how, and thus save costs. Such cooperation often emerges in research and development projects, which are characterized by higher risks and costs.[20] In recent years, the number of blockchain consortia has been steadily growing (from 25 in 2016[21] to 108 in 2019[22]).

Blockchain consortia can be divided into two types. The first is business-oriented, with consortium members aiming to solve one or more business problems (an example is the B3i consortium in the insurance industry[23]). The second is technology-oriented, where consortium members aim to develop platforms that serve as a universal infrastructure that can be used by different types of businesses (an example is Hyperledger[24]). There are examples of business-oriented consortia becoming technology-oriented (e.g., the R3 consortium, whose members are primarily banks and financial institutions developing a platform, Corda, suitable for transactions of any kind[25]).

Some blockchain consortia are international, while others focus exclusively on local markets. Consortia vary in size, from very small with only two or three members, to large with hundreds of members. Moreover, blockchain consortia may differ in their governance models and business goals. The variety, complexity and nature of this new type of inter-organizational collaboration, combined with growing levels of interest from managers and executives in the

[20] Ring, P. S., Doz, Y. L. and Olk, P. M. "Managing Formation Processes in R&D Consortia," *California Management Review* (47:4), July 2005, pp. 137-156.

[21] Mougayar, W. *The State of Global Blockchain Consortia,* CoinDesk, December 11, 2016, available at https://www.coindesk.com/state-global-blockchain-consortia.

[22] *Top Four Enterprise Blockchain Consortia Trends,* ESG Intelligence, June 19, 2019, available https://esg-intelligence.com/blockchain-articles/2019/06/19/top-four-enterprise-blockchain-consortia-trends-2019/.

[23] For information about B3i, see https://b3i.tech.

[24] For information about Hyperledger, see https://www.hyperledger.org.

[25] For information about R3 and Corda, see https://www.r3.com.

use of blockchain technology in enterprises,[26] calls for deeper understanding of the important factors to consider when deciding whether to join a blockchain consortium. Businesses intending to explore the potential offered by blockchain technology rely critically on the deliberate formation of consortia. However, the formation of blockchain consortia and their success criteria have received little attention in the literature.

This cardossier case study explicitly focuses on the core tensions involved in establishing a viable blockchain consortium. First, we identify the challenges associated with forming a "vertical" consortium that includes non-competing players from the car-related ecosystem, and we then discuss expansion of the consortium to include competing firms.

5.3 Three Phases of the cardossier Consortium's Evolution

The initial members of the cardossier consortium included multiple stakeholders from the private sector (an insurance company, an importer, an official car dealer, a car-sharing company and a software development partner), the public sector (a Swiss Road Traffic Agency) and two research institutions. The consortium was formed to address three specific problems:

- Inconsistent and unreliable data stored by different organizations in local databases
- Costly and cumbersome business processes for businesses and state organizations
- The lack of transparency and trust between individuals and organizations.

The consortium's goal is to build a reliable and secure "single source of truth" that removes the need to rely on a third party for data exchange and audit, and that involves various organizations from the car-related ecosystem with different interests and incentives.

The cardossier consortium has evolved through three main phases—Consortium Formation, Development of the Minimum Viable Product (MVP) and Preparation for Market Entry. Figure 2 shows the timeline of these three phases. The next stage, planned for 2020, is to enter the market.

[26] Lacity, M. C., op. cit., September 2018.

Figure 2. Timeline of the cardossier Consortium

During this three-phase evolution, the consortium faced several paradoxical tensions in three major areas: consortium management, business value and governance. Note, though, that there is overlap between these three areas. For example, governance is closely connected with business value and consortium management. Furthermore, the relative important of the areas varies over time. For example, in Phase 1 consortium management was very important for creating a stable collaboration; governance and business value challenges became more important as the project gets closer to market entry.

5.3.1 Phase 1: Consortium Formation

The first phase of the cardossier project included activities concerned with conceptualizing the idea, preparing the project and financial plans, and setting up the project. The project started in November 2016 as a research/innovation initiative by AdNovum,[27] a Swiss software company, and the University of Zurich,[28] with the initial goal of experimenting with blockchain, then a new technology. Inspired by the promised benefits of blockchain technology (i.e., trust and transparency between transacting parties), the collaboration started informally with idea-generation and conceptualization of the project.

AdNovum and the researchers set about identifying specific use-cases that could considerably benefit from trust enhancement. After considering several alternatives, the researchers identified the used-car market as a potentially relevant use-case for blockchain technology. This market was chosen because it suffers from a lack of trust and transparency, and there are information asymmetries between used car sellers and buyers. These problems in the used-car market were described in 1970 by Akerlof when he labeled bad secondhand cars as

[27] AdNovum (https://www.adnovum.ch/) is a leading security and identity management software provider in Switzerland, covering numerous business domains.

[28] Five information systems researchers from the University of Zurich are involved in the design and evaluation of the cardossier blockchain platform. Four of them are the authors of this article.

"lemons."[29] Akerlof's analysis is still relevant today, even in countries like Switzerland where levels of trust are relatively high.[30]

Because of these characteristics of the used-car market, the researchers defined *trust and transparency* as the targeted value proposition for the cardossier project. A blockchain provides data immutability, transaction transparency and network reliability, and promises a trust-free environment and authentication. With blockchain technology, rights and ownership can be transferred and verified, and therefore the technology enables "digital scarcity."[31]

The initial idea for the cardossier project was to document the history of a car and related transactions, and for this documentation to serve as proof of authenticity but not necessarily of transfer of rights. The cardossier business model was conceptualized as a data market that would financially incentivize data exchange: *"Data consumers will pay for access to the data, whereas data suppliers, data owners and, to a smaller extent, the operators of the blockchain will be rewarded."*[32] The intention was to create a simple app for private users of cardossier that would provide an overview of a car's history. Moreover, private users would be able to monetize data about their cars by providing access to interested parties.

Creating such a system without some form of collaboration would be almost impossible; participation by every type of player in the car-related ecosystem would be needed to collect a vehicle's data. On the one hand, the innovative nature of the project and the desire to quickly develop the technology solution meant that the consortium could not be too large. A smaller number of participants would ensure maneuverability and keep complexity manageable. A smaller consortium would also make it possible to determine early on whether the project would fail or succeed. Early indications of success would enable the consortium to gain a competitive advantage in the fast-growing blockchain application landscape.

On the other hand, the consortium needed a wide range of participants to ensure that comprehensive data covering the full lifecycle of a car could be collected. Thus, several businesses from the car-related ecosystem were invited to participate in the project. They were curious about the consortium because they were aware of the problems and market inefficiencies in the automotive sector, and of the fast-growing fascination about the use of

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[29] Akerlof, G. A. "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *The Quarterly Journal of Economics* (84:3), August 1970, pp. 488-500.

[30] For statistics about trust across countries, see Ortiz-Ospina, E. and Roser, M. *Trust,* Our World in Data, available at https://ourworldindata.org/trust.

[31] The best-known example of creating digital scarcity to enhance value is Bitcoin; only 21 million Bitcoins will ever be mined.

[32] Included in the funding application for the cardossier project.

technology. They also feared missing out on important developments in their industry. Some, however, were hesitant about joining the consortium. There were several reasons for their hesitation, which varied from partner to partner, and needed to be overcome. In summary, the main reasons were: (1) dependency on other participating partners (e.g., for some potential members, a governmental agency being on board was crucial); (2) no clear understanding of benefits the collaboration could offer their businesses; (3) negative reputation of blockchain technology, which might negatively impact their brand image; (4) regulatory constraints; and (5) insufficient resources.

In addition to AdNovum, the University of Zurich and Lucerne University of Applied Sciences and Arts, the following organizations became founder members of the consortium:

- AMAG,[33] the largest car importer and dealer in Switzerland, which would provide data about car production and import
- A Swiss canton Road Traffic Authority,[34] which would provide data about registration and regular mandatory checkups
- AXA Winterthur,[35] an insurance company, which would provide data about insurance policies and accident claims
- Mobility,[36] a car sharing company, which would provide car usage data (e.g., mileage, services and repairs).

Thus, several businesses from different parts of the car-related ecosystem were invited to participate in the project. However, possible competitors were initially excluded to avoid any conflict between them at the very beginning that might have endangered the project's success.

The cardossier was project seen as a high-risk innovation, which, if successful, would bring value to car-related businesses in Switzerland. However, although the initial project partners acknowledged the need for a solution in the car-related ecosystem—specifically in the used-car market—they were not willing to commit more resources or engage further at this stage. Thus to get the project off the ground, an application for research funding was prepared between October 2016 and May 2017, and submitted to Innosuisse,[37] the government agency

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33 AMAG has extensive knowledge on multiple phases of a car's lifecycle (e.g., its purchase, reselling, maintenance and regulatory aspects).

34 The Road Traffic Agency has data on many essential aspects of a car's lifecycle and can provide players in the car-related ecosystem with access to crucial data.

35 AXA Winterthur has data relating to all of the processes in a car's lifecycle associated with car insurance and gains significant benefits from an authenticated car history.

36 Mobility has extensive knowledge of the car-related ecosystem, and provides the project with insights on a car's lifecycle (e.g., maintenance, insurance claims, car-related data warehousing).

37 For information about Innosuisse, see https://www.innosuisse.ch/inno/en/home.html.

that fosters innovation projects with clear business value for the Swiss market. The application was successful and the funding helped to reduce the barriers to participation, encouraged the involvement of other organizations and demonstrated support from the government. These factors, together with the innovative nature of the project and awareness of the problems to be addressed by the project, fostered the successful formation of the consortium.

5.3.2 Phase 2: Development of the Minimal Viable Product

Phase 2 of the cardossier project included activities concerned with designing the system itself and identifying its business value for consortium members. When this phase started in October 2017, there was no specific structure for communication between participants. In total, around 20 participants were involved in the project, including members of the steering committee, the development and research teams, and industry partners. Participants were geographically distributed and did not have any experience of working together, and the project was innovative in terms of technology used and skills needed. The leaders of the project needed to work out how to establish communication between participants and create a common vision for the project. To ensure that all project members were not only up to date but also able to contribute to the project, an early decision was to set up regular meetings and calls. Given that innovation projects in general involve high levels of uncertainty and are experimental, the cardossier project had to be able to react to high levels of volatility in the requirements, Because of this, the project decided to use the Scrum software development methodology[38] to implement a permissioned blockchain for the minimal viable product (MVP). The main factors for choosing a permissioned blockchain were:

- The need for a shared common database for car-related data
- The involvement of multiple parties from the car-related ecosystem
- Conflicting interests of different players in the ecosystem
- Lack of willingness to trust a third-party provider
- The need for consensus between involved organizations
- The latest data protection regulations
- The trade-offs with respect to performance of transaction processing.[39]

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[38] For a brief description of Scrum, see *Scrum (software development),* available at https://en.wikipedia.org/wiki/Scrum_(software_development).

[39] For more on the factors to consider when choosing a blockchain type, see Pedersen, A. B., Risius, M. and Beck, R. "A Ten-Step Decision Path to Determine When to Use Blockchain Technologies," *MIS Quarterly Executive* (18:2), June 2019, pp. 99-115.

In theory, a centralized database could have aggregated data events from multiple parties, but the involved businesses realized that this could result in the emergence of a dominant player in the car-related ecosystem (akin to Google, Apple or Amazon). Having a single organization collecting and processing all car-related data would create a centralized power that would be a significant threat to, rather than a potential benefit for, individual industry segments and businesses. Thus, it became clear to the consortium that, in addition to the initial experimentation motivation that drove the choice of blockchain technology, economic considerations required a blockchain ledger. As an AdNovum project manager put it: *"Of course, we could have solved the collaboration challenges we had without joining a blockchain consortium, but we would still have come up with a blockchain solution."*

Another factor ruled out a centralized solution for the cardossier system. Although there was minimal competition among the initial participants (because each industry sector was represented by one business), the goal was to design a system that would be used by competing businesses. The vision is that multiple (ideally all) firms from all car-related industries should join the consortium in the future and add their data so that the system can be opened up to private users and therefore cover the entire used-car market. With that vision in mind, a centralized solution was not an option.

During the formation phase, the cardossier project had identified that the aim of the consortium was to resolve trust and transparency issues in the used-car market. However, the implementation of the MVP forced the consortium to narrow the scope even further. By analyzing the pain points along the lifecycle of a car, the consortium identified multiple opportunities for generating business value. The problems in the existing car-related ecosystem include inefficiencies in document management during the process of importing a car, inefficient and largely bespoke processes during repair and service of a car, and information asymmetries between car buyers and sellers. To decide which of these problem areas to focus on, the consortium evaluated the business value for each stakeholder involved in each problem area.

If the consortium were to focus on addressing the inefficiencies during the import process, the importer and the road traffic authorities would be the main beneficiaries. If it were to focus on addressing the largely bespoke car repair and service processes, insurance companies and garage services would benefit most, but this approach would not provide sufficient business value for other involved stakeholders. However, addressing the sale of used cars seemed to offer the same level of benefits to each stakeholder. Thus, the cardossier project decided to implement the MVP to support the sale of used cars because this focus would incentivize each stakeholder to provide data for the whole lifecycle of a car, and the stakeholders would later receive returns from the jointly created data market.

Figure 3 shows the prototype cardossier frontend (i.e., the user-facing cardossier app) developed as part of the MVP. This app was developed to be used by buyers and sellers of used cars, and provides basic data on a car to be sold, its history and assessment, and other information collected from data providers in the cardossier consortium. The technical implementation of the MVP backend was based on Corda distributed blockchain ledger technology.

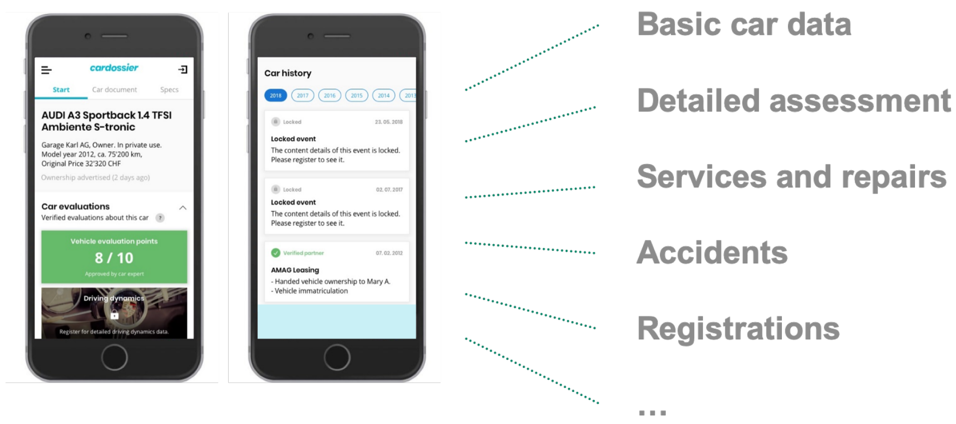

Figure 3. cardossier Frontend Prototype

Using blockchain technology for the backend enables the cardossier consortium to establish and store rights over data, which is both an economic and a technical necessity for the consortium. Blockchain technology can manage ownership rights (who owns the data), access rights (who can access the data), exploitation rights (who can use the data), sales rights (who can sell the data) and control rights (who can verify/control the data). Given that multiple parties would be involved in rights management, the consortium chose to implement a distributed ledger. The complex rights management requirements could be met because the stored data was unique and authenticated.

Technically, the consortium created a generic event-based data model and a role model. Certain car-related events, like registration or issuing an insurance policy, as well as the roles of those recording the events, were predefined. For example, insurance policies can only be created by insurance companies, and registration of a car can only be recorded by a registration authority. Recorded events were appended to cars, identified by their vehicle identification numbers. Attributes of the generic event included event ID, event type, event issuer, event owner, business date and a link to the actual content of the event, while the role model provided a mechanism for access control. Data privacy regulations and the design of rights management meant that only basic car data was replicated on each blockchain node and thus available to any consortium member. Detailed event data was replicated only on nodes that had the necessary rights (e.g., ownership or access rights).

5.3.3 Phase 3: Preparation for Market Entry

The third phase of the evolution (which is ongoing as of mid-2019) includes activities for preparing for market entry and expanding the consortium. During Phase 2, it became apparent that the consortium needed to become a legal entity for four key reasons:

- To obtain a critical mass of business users, and thus to create the network effects necessary for a successful data market, interested parties needed to sign up to a legal entity
- To prototype "real" processes, the consortium needed to be a "real" organization
- As a legal entity, the consortium would be able to sign-up more businesses, and thus, cover more participants from the car-related ecosystem
- As a legal entity, the consortium would have to adhere to a specific legal framework and comply with the relevant laws, which would help it in its aim of becoming a standard infrastructure for car-related data, and enable it to point to regulatory compliance as a measure of data quality.[40]

On becoming a legal entity, a legally constituted board was created with responsibilities for investing in data protection measures, complying with the legal framework and creating legal guidelines for the consortium and its individual members. The board had authority over the CEO and his office, with the CEO acting with a degree of autonomy on behalf of the consortium's members. This hierarchical structure created a tension that we discuss later in this article.

As mentioned earlier, the cardossier consortium was initially restricted to non-competing businesses from different parts of the car-related ecosystem. This was done to reduce the complexity of project management, while also obtaining data relating to most of a car's

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[40] Government authorities may create incentives for data quality (e.g., by applying sanctions for misusing data records or participants violating the system's rules). Such incentives would address—if not completely resolve—the conflict of interests between different types of users of the cardossier system, such as those providing high-quality data (e.g., owners of good cars, so-called "peaches") and those providing low-quality data or omitting data (e.g., owners of bad cars, so-called "lemons"). For more on data quality, see Zavolokina L., Spychiger, F., Tessone, C. J. and Schwabe, G. "Incentivizing Data Quality in Blockchains for Inter-Organizational Networks – Learning from the Digital Car Dossier," In *Proceedings of the 39th International Conference on Information Systems (ICIS 2018),* 2018.

lifecycle (production and import, insurance, registration, usage data, etc.). However, the overall goal is to encompass the entire car-related ecosystem. To achieve this goal and ensure the project's success, it would be necessary to sign up other businesses because:

- The system critically depends on the availability of car-related data; active data providers and consumers are crucial for the success of cardossier.
- Creation of a gap-free vehicle history is possible only if all market participants provide data about events throughout a car's lifecycle and make this data available for further use. For example, a single insurance company cannot provide data about insurance policies for all cars in the country; the participation of other insurance companies is needed to cover the whole market.
- Developing a commercial system, and other activities, such as project management, legal support, marketing and infrastructure, needs additional finance, and the consortium needs to recruit additional members to provide this finance. Although the founding members of the consortium agreed there was a need to expand to the broader market, funding this expansion remains one of the biggest challenges and risks for the consortium.

In general, as development of the cardossier system progressed, the value perspective shifted. Starting with the vision of providing an innovative product to meet the needs of an underserved market, the consortium members jointly created a distributed blockchain-based application. The architecture of the cardossier system (see Figure 4) now offers potential for value creation for each stakeholder on two dimensions.

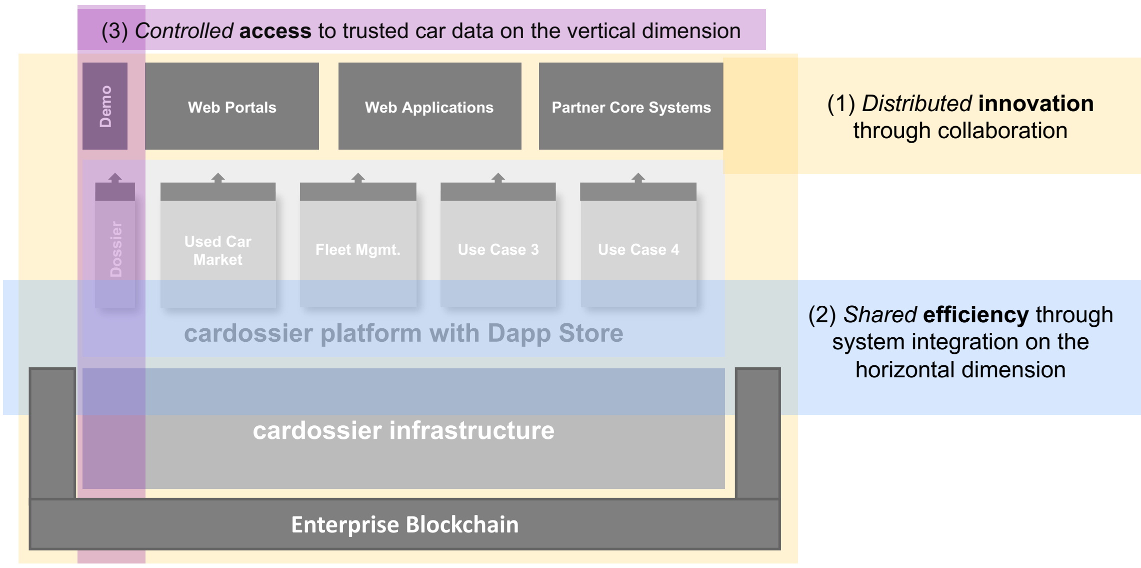

Figure 4. Architecture of the cardossier System

On the vertical dimension, the system offers a peer-to-peer (P2P) market for trusted car data, enabling stakeholders to make use of raw data through P2P data sales and purchases, or to provide services in the form of decentralized applications (available in the "Dapp Store,"[41]—the store for distributed apps). On the horizontal dimension, the system offers opportunities for shared operational efficiencies through system integration. This integration enables process inefficiencies and sources of failure between two or more business to be resolved.

The three value potentials of the cardossier project for each individual stakeholder[42] depicted in Figure 4 can be summarized as:

1. Distributed innovation through collaboration: the co-creation of a new distributed system architecture across businesses
2. Shared efficiency through system integration: the potential to minimize overhead costs through integrating and sharing processes
3. Controlled access to trusted car data: enabling competitive advantage though deeper insights from data.

In summary, the cardossier system architecture uses blockchain technology as the infrastructure to create a decentralized data storage and data market, on top of which is a platform that allows all participants to create and leverage value through deploying decentralized applications.

Creating an infrastructure, however, is only part of the story. Success for a network-enabling infrastructure such as that being built by the cardossier project depends on making a significant market impact. There were several measures taken by the cardossier project to ensure it reaches the broader market. Initially, the consortium was established as a non-profit organization. Membership was open to all players in the car-related ecosystem, and the non-profit nature of the consortium improved the trustworthiness and "good will" of the founding members. Second, public agencies were expected to commit to providing exclusive data to incentivize players such as importers to collaborate. Moreover, public agencies have regulatory power that, together with their data, means the system is increasingly perceived as a standard in the Swiss market.[43] The involvement of public agencies could lead to changes in the law that will oblige certain players to provide their data. Third, the large and well-known

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[41] For a detailed description of Dapps, see *What is Web 3.0?,* Web3 Developer, May 31, 2019, available at https://web3developer.io/what-is-web-3-0/.

[42] The three value potentials are described in more detail in Bauer, I., Liudmila Z., Leisibach, F. and Schwabe, G. "Exploring Blockchain Value Creation: The Case of the Car Ecosystem," in *Proceedings of the 52nd Hawaii International Conference on System Sciences (HICSS),* Maui, October 2018.

[43] The member from the Road Traffic Agency was appointed as president of the consortium.

brands involved in the consortium attracted the attention of the media, public and other organizations, which not only encouraged other organizations to join the consortium, but also spread the word through their business networks. Fourth, the critical mass of authenticated data and its availability was an important driver of adoption. While other platforms often adopt a user-centered approach to growth, focusing first on end users, the cardossier consortium followed a data-centered approach by offering authenticated data to businesses, with those businesses then driving the growth of end users.

When the cardossier consortium was preparing its medium-term financial plan, it evaluated the option of an initial coin offering (ICO)[44] in the form of a voting token. This form of token system would have allowed the distribution of voting rights to the initial founding members and potential new entrants. However, the steering committee decided not to pursue this option because it would have meant that the consortium would have to convince participants to commit to the project by viewing it as an investment. Even though voting tokens might have made it easier to gain commitment from the stakeholders, the view was that this approach would have attracted participants with the wrong motivations. Rather than encouraging financial investors to join the project, the consortium aimed to recruit actively participating stakeholders.

At the time of preparing the medium-term financial plan, it was difficult to estimate the value stakeholders would gain from the cardossier project. A rough estimate of potential revenue from the consortium's use-case (the used-car market) existed, but the majority of stakeholders agreed that cardossier offered the potential of much more value from additional business cases that would exploit the data market the project was creating. Thus, the consortium decided to offer members opportunities for future value creation by providing the ability to join development efforts and to design applications that would generate revenue for their individual businesses.

In other words, the cardossier consortium decided to create a membership model that offers different membership categories to potential members. These membership categories not only manage the voting rights (as they would have with the investment approach) but also give members the right, for example, to deploy their own applications in the cardossier platform using the Dapp Store. This approach incentivizes both potential and existing founding

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[44] For information on blockchain token design, see Oliveira, L., Zavolokina, L., Bauer, I. and Schwabe, G. "To Token or not to Token: Tools for Understanding Blockchain Tokens," in *Proceedings of the 39th International Conference on Information Systems (ICIS 2018),* 2018.

consortium members to not only invest financially but also to join development efforts and thus enhance distributed innovation.

The decision not to encourage financial equity stakes was consistent with the overall vision of the cardossier consortium to not directly maximize the value generated for its members. Instead, the consortium set out to create a platform that will enable members to create their own businesses built around cardossier data and be responsible for maximizing their own profits. The consortium is aiming to build an open infrastructure and a platform available to all firms from the variety of industries involved in the car-related ecosystem, not just to selected players.

5.4 Resolving Tensions in the cardossier Consortium

Six key tensions arose during the evolution of the cardossier consortium (see Table 22). We examine these tensions through the paradox[45] perspective and show how they were resolved. The paradox perspective has two components: (1) a contradiction between two propositions (the tension) and (2) resolution of the tension.[46] In management science, the paradox perspective offers four coping strategies for resolving a paradox between A and B: (1) *Acceptance:* keeping A and B separate and their contrasts appreciated; (2) *Spatial separation:* situating A and B at two different levels of analysis; (3) *Temporal separation:* switching between A and B in the same location at different points in time; and (4) *Synthesis:* finding a new perspective that eliminates the opposition between A and B. Below, we show which specific strategies were applied to resolve the paradoxes that arose during the evolution of the cardossier consortium.

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[45] Schad, J., Lewis, M., Raisch S. and Smith, W. K. "Paradox Research in Management Science: Looking Back to Move Forward," *The Academy of Management Annals* (10:1), April 2016, pp. 5-64; the authors define paradox as a "persistent contradiction between interdependent elements."

[46] Poole, M. S. and Van De Ven, A. H. "Using Paradox to Build Management and Organization Theories," *Academy of Management Review* (14:4), October 1989, pp. 562-578.

Area	Tensions			Resolutions
Consortium Management	Creation of a system to enable trustless collaboration	vs.	Need for inter-organizational trust	*Synthesis*: Trust in execution and maintenance vs. trust in design
	Cooperation and collaboration	vs.	Disintermediation	*Synthesis*: Shaping vs. using the platform
Business Value	Improving integration and operational efficiencies	vs.	Improving market transparency	*Temporal separation*: Short-term vs. long-term
	Platform	vs.	Infrastructure	*Spatial separation* of system architecture: Infrastructure vs. platform with Dapp Store
Governance	Openness to all to enable comprehensive coverage	vs.	Selectiveness to enable competition	*Spatial separation* of system architecture: Infrastructure vs. platform with Dapp Store
	Hierarchical effectiveness	vs.	Democratic efficiency	*Temporal separation*: Short-term vs. long-term *Spatial separation* of system architecture: Infrastructure vs. platform with Dapp Store

Table 22. Tensions in the cardossier Consortium and their Resolutions

5.4.1 Consortium Management Tensions

Creation of a System to Enable Trust-free Collaboration Vs. Need for Inter-organizational Trust. Right from the start, the cardossier consortium faced tension between creation of a trustless system for transactions vs. the need for mutual trust between participating organizations. The consortium aimed to create a system for trustless collaboration that would allow individuals and firms to transact without the need to trust each other. However, to jointly work toward this goal, mutual trust between member organizations in the consortium had to be established. Before work started on developing the cardossier system, there was much discussion and design activity aimed at finding common ground and understanding needed to establish collaboration.[47]

While blockchain technology offer a trustless environment, it very quickly became clear that the choice of blockchain technology was driven more by economic rationales than by technological considerations. The two key economic rationales that made it clear blockchain technology was the right choice were the needs for collaboration and for power sharing. The consortium businesses understood that to address the lack of trusted car data throughout the lifecycle of a car, all car-related industries and agencies needed to collaborate; only then would the consortium be able to digitize all data relating to a car throughout its lifecycle.

This is how the necessary trust was established between consortium partners. During Phases 1 and 2 (Consortium Formation and Development of the MVP), when membership was restricted to non-competing organizations, it was important to create transparent and open communication, clear information flows and consensual decision making within the consortium. As mentioned earlier, at the start of the formation phase regular meetings and calls were instituted to keep all consortium members up to date and fully engaged. The organizational structure was also established during this phase and the distribution of roles was agreed. There were four organizational components: the steering committee, project management team, operational team and research board.

The steering committee evaluated project results and made decisions about the subsequent development activities. The operational team met face-to-face every three weeks and had weekly calls. Given that innovation projects in general involve high levels of uncertainty and are experimental in nature, the operational team adopted the Scrum software development methodology, which enables developers to cope with a high level of volatility in the requirements. The project management team used collaboration tools to maintain communication and project documentation, and to track progress.

To foster a culture of open communication and trust, the consortium decided that members should have equally distributed voting rights.[48] Several other options for distributing voting rights among members (according to their engagement or capital shares, and the one-

[47] Miscione, G., Goerke,T., Stefan, K. et al., *From authentication to 'Hanseatic governance': Blockchain as Organizational Technology*, London School of Economics and Political Science, January 2019, available at https://researchrepository.ucd.ie/handle/10197/10575.

[48] This decision might be reconsidered in the future.

member, one-vote model) were considered at the start of the formation phase, but none of these was thought to be appropriate.

In summary, the discussion on trustless collaboration vs. the need for trust shifted from a purely technical to a sociotechnical perspective. As a consequence, this consortium management tension was resolved by separating the perspective on future execution and maintenance from the perspective on design. While the future execution and maintenance perspective requires trust in the benevolence of the whole community and node operators, the design perspective recognizes that trust should first be built up between organizations involved in design activities, and consensual decision making should be applied for crucial design decisions.[49]

Cooperation and Collaboration Vs. Disintermediation. Blockchain solutions often aim to disrupt intermediaries[50] but, in contrast, individual members of a blockchain consortium aim to leverage the technology to retain their market positions in the future. The agreed long-term goal of the cardossier consortium is to create a decentralized market for data relating to cars. However, through workshops and interviews with stakeholders, the founding members of the consortium realized that this goal should not—and could not—be achieved right away. Thus, the defensive strategy the consortium followed was not to disrupt current established organizations but instead to first enable efficiency increases in inter-organizational processes. These efficiency increases could, of course, be achieved through a centralized solution, but such a solution would be incompatible with the long-term vision of a fully decentralized data market.

The medium-term (shared operational efficiency) goal and the long-term (disruptive innovation) business vision had different business drivers. Operational efficiency would help businesses to achieve quick and effective results from the project, which in turn would result in continued development funding. Achieving the long-term vision depended on the initial data provided for the cardossier system kick-starting a rapid evolution toward a decentralized data market that individual data buyers and sellers could profit from. Focusing initially on operational efficiencies would provide quick benefits for the businesses involved in the consortium but would not close the door on the long-term vision of disruptive innovation.

[49] For information on crucial design decisions for blockchain systems, system evolution and the role of trust, see Ziolkowski, R., Parangi, G., Miscione, G. and Schwabe, G. "Examining Gentle Rivalry: Decision-Making in Blockchain Systems," in *Proceedings of 52nd Annual Hawaii International Conference on System Sciences (HICSS),* Maui, January 2019, available at http://hdl.handle.net/10125/59891.

[50] The most obvious example is cryptocurrencies (e.g., Bitcoin), which are a form of digital currency that doesn't involve banks.

By actively participating in the design of the initial system, the founding consortium members gained valuable knowledge that would later help to achieve the long-term vision. Moreover, the consortium gained a time advantage, placing it ahead of possible competitors, either decentralized or centralized, or inside or outside the car-related ecosystem. What's more, individual businesses were able to gain an understanding of the business value of blockchain technology and how they could use it to reposition themselves and survive in the future.

In summary, the cooperation and collaboration vs. disintermediation consortium management tension was resolved by separating the two activities: shaping and co-designing the system to achieve operational efficiencies today, and considering the potential for new business benefits when using the cardossier platform in the future.

5.4.2 Business Value Tensions

Improving Integration and Operational Efficiencies Vs. Improving Market Transparency. Shifting the focus at the beginning of the project from improving market transparency to improving integration and operational efficiencies opened up a new tension between these two aims. While the long-term goal is to bring trust and transparency into the car-related ecosystem, the consortium members realized that problems of data exchange between organizations should be solved first for two reasons. First, a valuable and high-quality cardossier system would not be possible without authenticated data, provided by organizations involved throughout the lifecycle of a car. The system would be less valuable if some organizations do not participate or do not have the motivation or capabilities to provide their data. Second, operational efficiency is a common problem that unites the interests of businesses and can be solved only by businesses that collaborate effectively. This tension and the initial business-to-business (rather than consumer-to-consumer) orientation of the cardossier project are closely interrelated.

The long-term vision is to make the whole used-car market more transparent to better serve the needs of car owners—for example, in managing transfers of titles of ownership. Car owners are mostly private individuals. However, the short-term goal is to attract businesses and serve their needs through creating standards for car-related data. One of the reasons for the initial business-to-business orientation is prioritization: it would not be possible or expedient to serve all segments (i.e., business-to-business, business-to-consumer and consumer-to-consumer) from the outset. The long-term vision of creating a consumer-to-consumer platform for the used-car market cannot be achieved without having businesses onboard, so the first priority is to get them using the platform. However, from the beginning of the cardossier project, there were research activities that explored private users' needs and possible usage of the platform.

In summary, the business value tension of improving integration and operational efficiencies vs. improving market transparency was resolved by temporal separation between the short-term and long-term orientations of the cardossier platform.

Platform Vs. Infrastructure. The second business value tension related to whether the cardossier system is a platform with a modular architecture that creates a two-sided market for car-related data exchange, or an infrastructure that enables access to and usage of this data as well as integration of all inter-related processes. From a technical perspective, a platform has a programmable stable core system with modular variable components, whereas an infrastructure connects heterogeneous systems and networks.[51] From an economic perspective, a platform is designed to provide private benefits and is often profit-oriented, and can frequently be updated as the competitive environment changes, whereas an infrastructure is a commodity (and usually non-profit) service that is designed for long-term sustainability. In terms of governance, a platform is governed privately by one company or a consortium of companies and is designed to enable competition, whereas an infrastructure is often governed and maintained by the government, which acts as a monopoly supplier and exerts strong controls over its use.

From the economic and governance perspectives, the cardosssier system can be considered as both a platform and an infrastructure. The ambition is for the system to become a basic infrastructure and the standard for car-related data exchange. Indeed, some of the prerequisites for it becoming an infrastructure are already in place, like government-level support and creating a system for the public good. However, the cardossier system can't become an infrastructure until it has proven its value as a platform with the ability to align the interests of all involved parties. Thus, the future evolution of the system might be termed as "infrastructuralization of the platform."[52] An important feature of the cardossier system is that it not only provides a platform for deploying apps in the Dapp Store, but also provides an infrastructure for accessing high-quality authenticated data relating to transactions and events in the car-related ecosystem.

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[51] Zavolokina L., Spychiger, F., Tessone, C. J. and Schwabe, G., op. cit., 2018.

[52] For more on platformized infrastructures and infrastructuralized platforms, see: (1) Plantin, J.-C., Lagoze, C., Edwards, P, N. and Sandvig, C. "Infrastructure studies meet platform studies in the age of Google and Facebook," *New Media & Society* (20:1), August 2016, pp. 293-310; and (2) Ziolkowski, R., Miscione, G. and Schwabe, G. "Consensus through Blockchains: Exploring Governance across inter-organizational Settings," in *Proceedings of the 39th International Conference on Information Systems (ICIS 2018),* 2018.

In summary, the business value tension of platform vs. infrastructure was resolved through spatial separation of the system architecture.

5.4.3 Governance Tensions

Openness to all to Enable Comprehensive Coverage Vs. Selectiveness to Enable Competition. The cardossier consortium is aiming to create both a platform and an infrastructure for car-related data that is open and fair in two ways: (1) any player from the car-related ecosystem may join and leave it; (2) decisions about design, development and strategy require consensus among consortium members. To ensure fairness in both these ways, the consortium needed to establish an appropriate distributed governance mechanism for a blockchain platform that allows a network of different participants to evolve.

However, before focusing on the long-term vision of distributed governance, the consortium had to ensure that it could run successfully in the short term. A stable governance mechanism had to be in place to keep the consortium functioning and to evaluate if the necessary collaboration was achievable on a small scale, and could still be achieved when more members joined in the future. Without collaboration between the initial non-competing consortium members the data would be incomplete. But it became apparent that to address the whole market (all cars in Switzerland), sooner or later collaboration between competing businesses within the same industry segment would also be required.

As discussed earlier, establishing mutual trust and understanding among consortium members was a prerequisite for building the trustless cardossier platform. The consortium used well-established IT governance practices to facilitate collaboration and establish off-chain [53] governance. However, blockchain technology provides new opportunities and challenges, in particular for predefining rights and decisions and executing them by code, and thus automating them as a part of on-chain[54] governance. The consortium therefore needed to determine, up front, the rules that would govern the platform; once the rules had been determined, it would be hard to reach a consensus to change them.[55]

Initially, each industry sector was represented by one business in the consortium, so there was little competition among the members. However, the overall goal is that multiple (ideally all) firms from all car-related industries will eventually join the consortium and provide their data

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[53] Off-chain processes are performed without the help of blockchain technology.

[54] On-chain processes involve smart contracts, which are agreed upon, encoded and immutable within the blockchain system.

[55] For more information, see, Miscione, G., Goerke,T., Stefan, K. et al., op., cit., January 2019.

so that the cardossier system can cover the entire used-car market. Achieving this vision not only requires a decentralized solution, but also needs a platform with a more modular architecture. A modular architecture will allow consortium members to create their own services on top of the platform, and thus move competition in the market from the physical to the digital, blockchain-based, space.

While the founding members of the consortium agreed that the long-term aim is to expand to the broader market, achieving this remains one of the prominent challenges and risks for the consortium. When competing businesses begin to join the consortium, [56] the initial cooperation relationship will change to one of "coopetition." As well as creating a common good—the cardossier infrastructure—and achieving common benefits, like cost reduction, easier access to data and knowledge, the participating businesses will still compete against each other with their products and services and in the ways they leverage the data obtained from the cardossier system.

In summary, the governance tension of openness to all to enable comprehensive coverage vs. selectiveness to enable competition was addressed by spatial separation of the cardossier infrastructure and platform. The infrastructure provides access to the data and regulates data exchange, whereas the platform with its Dapp Store facilitates competition between consortium members.

Hierarchical Effectiveness Vs. Democratic Efficiency. A second governance tension existed from the moment the cardossier consortium was founded. Although the vision is for democratic governance with decision making supported by blockchain technology—i.e., on-chain governance—the consortium decided to initially implement a simplistic and more traditional hierarchical governance structure—i.e., largely off-chain governance. This decision was driven by the innovative character and high level of risk of the initiative, and by the need to later expand the consortium. It was essential to start with a governance structure that would facilitate an effective working organization able to bring the cardossier system quickly to market and create a vibrant ecosystem around it.

To implement this governance structure, a strong board of directors was appointed, along with executive-management and operational teams. The advantages of this approach are that board members, the CEO and the cardossier office steer the consortium relatively autonomously while taking account of members' wishes, which allows for faster decision making, at least by senior management. The approach also allows consortium members to

[56] After drafting this article, several competing businesses have joined the consortium (as of autumn 2019).

safeguard their interests more easily as they can exercise control locally. And, as mentioned earlier, adhering to a specific legal framework provides advantages for structuring cooperation, both for development efforts for resolving any conflicts—e.g., concerning the reversal of transactions or disputes about ownership. Thus, as the consortium prepares for market entry, the governance priorities are hierarchical effectiveness and legal considerations.

In the longer term, however, the governance focus will switch to democratic efficiency, when decision making, assessing the impact of individual players and reaching consensus are supported by blockchain technology. In this respect, blockchain technology can be thought of as a kind of accounting system where a blockchain token could represent one vote. To make voting distribution fairer, smart contracts could automatically update voting rights in line with a consortium member's activity and involvement in terms of, for example, financial contribution, code contribution, voting activity or data correction. Many of these activities are conducted on-chain or at least in a digital form, which may serve as data feeds to the cardossier system. Note that voting and assessing a member's involvement takes place on-chain via code and does not rely on an intermediary.

With these potentials of blockchain technology in mind, the consortium decided to postpone the implementation of a full-blown on-chain governance until the cardossier ecosystem was more stable. In other words, the governance tension of hierarchical effectiveness vs. democratic efficiency was resolved by temporal separation of the short-term and long-term goals as well as through spatial separation of the system architecture.

5.5 Insights from the cardossier Project

We gained three insights from our involvement in the cardossier project. These insights will be of value to enterprises considering whether to join and collaborate in a blockchain consortium.

5.5.1 Blockchain Solutions Encourage Collaboration, but Require Initial Mutual Trust

The reasons for enterprises engaging in blockchain-enabled inter-organizational collaboration include curiosity and interest in a new technology, its promised business benefits (trust, transparency and efficiency, resulting in cost savings), fear of missing out or being disrupted, and access to new forms of collaboration. This article has shown that one form of collaboration is to join a blockchain consortium. However, mutual trust within the consortium is an important aspect to achieve success in this collaboration. Thus, when deciding whether to join a consortium, digital transformation leaders should seek answers to the following questions: Who are the collaborators? Are they ready to shift their mindset to create a common good that can also bring benefits to individual consortium members in the longer term? Are they ready to share financial costs and intellectual property rights? What does the collaboration mean for their organizations?

The cardossier case study shows that starting with a "vertical" consortium (i.e., one where most members do not compete with each other) reduces the risk of unnecessary conflicts between competitors that might kill the project in an initial phase. This type of consortium also provides consortium members with a better understanding of related businesses and business processes. However, for a consortium to be successful in the long run its blockchain solution will have to widely adopted, and to achieve this participants should be prepared for the challenges of moving to a "horizontal" consortium where members compete against each other.

5.5.2 Blockchain Technology Enables Distributed Value Generation in a Digital Ecosystem

Permissioned blockchains provide an opportunity to transfer market principles and rules from the physical to the digital world, thus, enabling distributed value generation in a digital ecosystem. Blockchains, per se, do not eliminate competition or create a monopoly. A blockchain platform where players know each other allows a more transparent and trusted environment in which each player can conduct its daily business, create a competitive advantage in the market and provide value for its customers. Although the ecosystem around a blockchain can only be created collaboratively, each enterprise in a blockchain consortium can gain individual benefits from the technology. Achieving these individual benefits, however, requires a clear separation of long-term and short-term priorities and market orientations. Initially, consortium members should focus on resolving inter-organizational efficiency problems (i.e., a business-to-business market orientation) and only later address the business-to- consumer and consumer-to-consumer markets.

5.5.3 Laws and Regulations are Key to the Success of Blockchain Projects

Blockchains authenticate data and transactions and allow the transfer of digital value, functions that traditionally are governed by legal regulations. Laws and regulations can enable and drive blockchain innovation but can also hinder it. Regulators can play different roles in a blockchain consortium. They can act as supporters who transfer the regulatory requirements into the development, or as gatekeepers who control and incentivize data quality, or as orchestrators who enable and intervene in situations that require settlement. Moreover, a blockchain consortium should be established as a legal entity, which will facilitate the combining of on-chain and off-chain governance functions and foster market penetration and standardization. Although some governance functions may be "outsourced" to blockchain code (in the form of smart contracts), making them more efficient, the reality is that off-chain governance is still needed where the technology reaches its limits. At first glance, collaborating through a blockchain consortium might seem to be primarily concerned with the technology itself, but governance and legal considerations also play an important role and cannot be ignored.

5.6 Concluding Comments

The growing number of blockchain consortia is providing both opportunities for new forms of collaboration built around the potential benefits of blockchain technology, and uncertainty caused by the tensions such collaborations bring. In this article, we have provided insights from the way the cardossier blockchain consortium faced and resolved these tensions, which arise in three areas—consortium management, business value and governance. The cardossier consortium is an example of a new type of blockchain collaboration that requires structures and governance mechanisms that may differ from traditional ones.

Blockchain technology is not only an enabler of inter-organizational collaboration. It also facilitates the way businesses transact with each other and leads to a new type of organization (a blockchain consortium) that has a distinctive governance structure and legal foundation. However, there is still much work to be done to understand how blockchain consortia and their platforms become blockchain organizations and ecosystems. Reports on the experiences of enterprises involved in endeavors such as the cardossier consortium are a valuable step in the right direction.

5.7 Appendix: Research Methodology

This study is a part of a larger Action Design Research[57] project (the "Blockchain Car Dossier"), funded by Innosuisse. This project is an example of how information systems research moves through "the last research mile"[58] and uses solution-based probing[59] to assess the viability of an innovation and create deeper understanding of design rationales. Such projects move from proof-of-concept to proof-of-value, finally reaching proof-of-use. Proof-of-concept research demonstrates the existence of an important class of unsolved problems along with the technical feasibility of a solution. Proof-of-value research demonstrates empirically the potential worth of a solution in lab or field studies. Proof-of-use research demonstrates that a self-sustaining and growing community of practice has emerged around the solution.

All authors of this article are involved in the design and development of the proposed cardossier platform as well as in setting up the consortium, including the business model and governance. The cardossier case study presented in this article is based on interviews with project partners, project documentation, data from workshops and regular project meetings, and observations. These activities ran from November 2016 to February 2019.

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[57] Maung K. S., Henfridsson, O., Purao, S. and Rossi, M. "Action Design Research," *MIS Quarterly* (35:1), March 2011, pp. 37-56.

[58] Jay, F. N., Briggs, R. O., Derrick, D. C. and Schwabe, G. "The Last Research Mile: Achieving Both Rigor and Relevance in Information Systems Research," *Journal of Management Information Systems* (32:3), July 2015, pp. 10-47, available at https://doi.org/10.1080/07421222.2015.1094961.

[59] Böhmann, T., Schwabe, G., Briggs, R. O. and Tuunanen, T. "Advancing Design Science Research with Solution-based Probing," in *Proceedings of the 52nd Annual Hawaii International Conference on System Sciences (HICSS),* Maui, January 2019.

6 PAPER V: Mine, Yours … Ours? Managing Stakeholder Conflicts in an Enterprise Blockchain Consortium

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Abstract

When major corporations build and manage own platforms, most of the conflicts are resolved internally. With the rise of blockchain systems, also blockchain-based platforms are increasingly tried out, which are governed in a decentralized fashion. But moving from hierarchical efficiency to a democratic inclusiveness, in which blockchain proponents believe, is difficult: the variety of included actors raise a variety of conflicts, when platform users become platform complementors or even owners. To manage these conflicts, it is necessary to analyze each actor in detail. This paper reflects on the developments within an ongoing enterprise blockchain consortium in a small European country in the automotive domain from a governance perspective. We portray the consortium's stakeholder conflicts, propose solutions for these conflicts and relate them to literature on blockchain governance. Our findings contextualize several theoretical stances for blockchain governance, while emphasizing the importance of the organizational embedment of blockchain technology over technical-oriented stances.

Acknowledgments

This research has been funded by Innosuisse (a Swiss government agency) as part of the "Blockchain Car Dossier" project. This project is a collaborative effort, and many of the ideas presented in this article result from many hours of discussion and endeavor involving the whole project team.

6.1 Introduction

With Bitcoin celebrating its tenth anniversary, blockchain technology continues to attract significant attention in both academia and practice. Thereby, blockchain technology evolved from an enabler from cryptocurrencies to a novel architecture of organizing, transacting, and sharing data in a decentralized manner (Ziolkowski et al., 2020b). This high level of interest in practice is particularly reflected in the growing number of blockchain consortia (Gratzke et al., 2017). In such a consortium, as one instance of an inter-organizational (IO) collaboration, different companies join forces to mutually develop, maintain, and run a blockchain-based system. Main drivers for these efforts are, among others, promises for novel products, process efficiencies, or greater customer intimacy (Bauer, Zavolokina, Leisibach, et al., 2019). These promises, however, are not new, as previous research on IO collaboration shows. Reasons like missing management commitment, mistrust, or vested interests are prominent (Fawcett et al., 2015). Dealing with these makes the management and alignment of stakeholder a crucial component.

Blockchain systems, on first sight, stand at odd with concepts like stakeholder management. In their early days, the governance of blockchain systems like Bitcoin, which is one of the most prominent blockchain systems to date, followed principles known from the free-and-open-source software (FOSS) development domain. In these, actors are mostly independent from each other, tend to stay anonymous, and not bound to a particular version of software. These principles make stakeholder alignment methods known from the corporate domain unfeasible. However, blockchains differ from FOSS as blockchains rely on a mutual dependence of software developers, maintainers, and other third parties to assure the system's continuity, security, and also its token's value (Miscione et al., 2018; Ziolkowski et al., 2018). And this mutual dependence has a caveat: the inability to manage these stakeholders' interests repeatedly threatened blockchain systems, most famously Bitcoin (De Filippi & Loveluck, 2016b). Alternative governance concept were tried out (Miscione, Klein, et al., 2019; Rossi, Mueller-Bloch, Thatcher, & Beck, 2019), which led to the emergence of decentralized autonomous organizations (DAOs) (DuPont, 2018) and blockchain consortia. Here, we focus on the latter, which account for network-type settings based on reciprocity, a varying degree of trust, and known actors.

Several researchers call for research on stakeholders of blockchain systems (Beck et al., 2018; Pelt et al., 2020; Rossi, Mueller-Bloch, Thatcher, & Beck, 2019), as an improved understanding of stakeholders is a prerequisite to manage potential conflicts and, thus, contribute to a better blockchain governance. This paper contributes to these calls by exploring stakeholder interests, conflicts, and possible ways of managing these with a focus on blockchain consortia. To do so, we report from our involvement in a blockchain consortium in the automotive industry in a small European country, called "CarCon" (anonymized). There, we designed and later strove to improve CarCon's governance. A necessary step to do so has been to understand, what (1) stakeholder conflicts there were and (2) how these potentially could be resolved. We utilized various data sources, such as official project meeting minutes, notes taken as participant-observer throughout the project duration, as well as 8 interviews with senior managers from the project. Even though blockchain consortia operate differently from public and permissionless blockchains like Bitcoin, we believe several conflicts to overlap because of a blockchain's characteristics, as we will argue below. Our research was led by the following research questions:

RQ 1: Which stakeholder conflicts can be observed within CarCon?

RQ 2: How could these conflicts be resolved by a Blockchain Governance?

RQ 3: How do these conflicts and resolutions relate to Blockchain Governance?

This paper is organized as follows: we outline related work in the following section. After detailing our methodology, we introduce the case of CarCon. Then, we show central stakeholder conflicts within CarCon and possible resolutions to these. In the discussion, we relate observed stakeholder conflicts to blockchain governance literature. We conclude by outlining its limitations and showing potential venues for future research.

6.2 Related Work

Academic interest and its body of knowledge on blockchain technology rapidly increased over time. Against this background, this section highlights related work on modes of governance, blockchain governance and its evolution, and shows the importance of a stakeholder-oriented view on blockchains.

6.2.1 Markets, Hierarchies, Networks and Online Modes of Governance

At its core, governance describes how order between different parties is established (Williamson, 1985). Dealing with stakeholders, i.e., in terms of conflict resolution, is highly contingent on the mode of governance – or order – in which (trans-) actions take place. Modes of governance can be classified into hierarchies (control and authority) and markets (price and free choices) (Williamson, 1975b). The network mode of governance extends this dichotomy by introducing a relational view on actors, which share a common goal, and whose collaboration is based on reciprocity (Powell, 1990). These modes of governance do not account for online phenomena, such as commons-based peer production (Benkler, 2017). FOSS is an instance of the latter, and several authors argue that blockchain systems have their roots in these (Miscione, Klein, et al., 2019). FOSS is typically characterized by no central steering entity, use of open licenses to promote co-development, and informal relations among actors (Demil & Lecocq, 2006). Thereby, FOSS stands as an example of how established governance mechanisms, and thereby stakeholder management, are altered by technology. For example, hierarchical control becomes unfeasible, due to its "structurelessness" (Freeman, 1972), open licenses are limiting clear property rights, which are necessary for market, and relational contracting is hindered by anonymity. This is in line with several authors who argue blockchains to alter existing (Allen et al., 2020) or to constitute new (Miscione, Klein, et al., 2019) forms of governance, which affects stakeholder relationships and stakeholder management.

6.2.2 Fundamentals of Blockchain Systems

As this paper focuses on blockchain governance in terms of stakeholder conflicts, technical details of a blockchain system are only introduced to the extent they are necessary. We define blockchain systems as a "blockchain application and (its) organizational embedment" (Ziolkowski et al., 2020b). Blockchains rely on the principles of anonymity, persistency, auditability, and decentralization (Zheng et al., 2017b). These principles depend on the applied blockchain type. An important concept to blockchains are so-called smart contracts, which, in layman's terms, constitute encoded, self-enforcing business logic (Gatteschi et al., 2018), which is often linked to reduction of transaction costs. Automation depends on deterministic inputs, evaluation criteria, and outputs; as a result, smart contracts are well-suited for routine tasks with predictable outcomes, but ill-suited for personalized tasks with unknown outcomes (Gatteschi et al., 2018).

The most common and researched blockchain type to date refers to public and permissionless blockchains, such as Bitcoin (De Filippi & Loveluck, 2016a). In contrast, mostly so-called private and permissioned blockchains (Peters & Panayi, 2015) are tried out in blockchain consortia. In these, various use-cases are tried out (Morabito, 2017b), for example, in supply chain tracking (Choi, 2019), land registration and transfer (Kramer, 2018), and many others. One has to differentiate business blockchain consortia, such as the latter, from technology-oriented consortia, such as Hyperledger (Androulaki et al., 2018). Our study focuses on one instance of a business blockchain consortium. We define the latter as an IO network of multiple companies working together toward a common purpose utilizing blockchain technology (adapted from Popp et al. (Popp et al., 2015).

6.2.3 Stakeholder Conflicts and Blockchain-based Systems

The alignment of stakeholders is repeatedly considered central for successful projects (Beringer et al., 2012). To strengthen this alignment, literature streams such as Project Management offer helpful tools, such as weighted decision matrices or organizational design analysis (Kates & Galbraith, 2010). These tools proved helpful in the corporate domain, in which bureaucratic control can be applied. But even in these, researchers have repeatedly unfolded the complexity of internalities of companies, where stakeholder management has been seen as a fundamental activity for project success (Beringer et al., 2012). In contrast, bureaucratic control becomes unfeasible in inter-organizational (IO) networks (Powell, 1990), where parties work together as long as benefits succeed costs: reasons for IO networks to form can vary, from access to and leveraging of resources, seamless service quality and coordination, mutual learning through knowledge exchange, innovation, or sharing risks (Chi & Holsapple, 2005a; Popp et al., 2015). Consequently, IO networks are often found to be hindered or even failing due various reasons such as cultural clashes or power imbalances (Popp et al., 2015), or missing alignment of stakeholder interests (Gupta, 1995). These stakeholder interests can vary greatly: from business conflicts on competition within or outside a consortium (Popp et al., 2015), or regulatory conflicts (Pólvora et al., 2020). To meet these challenges, it is vital to obtain a detailed understanding of these organizational arrangements (Popp et al., 2015; Seebacher & Schüritz, 2017), especially in regard to the novelties blockchains bring. Seebacher and Schüritz (Seebacher & Schüritz, 2017) contrasted known challenges in IO information systems implementation against challenges brought forward by blockchain technology: while the majority of challenges are similar, they conclude, that, among others, blockchain's promise of decentralization – especially on an organizational level – stands contrary to IO practices, where central stakeholders eventually build their own hierarchy due to their higher negotiation power (Hekkala & Urquhart, 2013).

Complementary to a transaction-cost-centric view, principle-agent conflicts (Eisenhardt, 1989a; Moldoveanu & Martin, 2001) add an additional perspective on stakeholder conflicts. At its core, it deals with one party (principal) delegating work to another (agent), and possible conflicts among these, such as diverging goals or attitudes towards risk (Moldoveanu & Martin, 2001). Principle-Agent conflicts can be resolved in several ways, such as direct supervision, lowering information asymmetries, establishing shared values, or proper incentivation (Moldoveanu & Martin, 2001). Similarly, in blockchain systems, several of these are being applied: for example, central operations, such as mining, place incentives to assure honest mining behavior, and information asymmetries are lowered through publicly visible transactions or change proposals (Ziolkowski et al., 2020a). Aside from the blockchain system operation, a central principle-agent conflict in the blockchain domain revolves around the inability of users to assess ongoing developments around a project (De Filippi & Loveluck, 2016b): often, change proposals are written in technical terms, which necessitates knowledge on technicalities, which users are either lacking or simply not up-to-date. Consequently, users, at least to a certain degree, must trust core developers to act honestly, while having limited means to assess their work. This centrality of technical knowledge but also on technical decision rights is discussed widely in blockchain governance literature (De Filippi & Loveluck, 2016b; DuPont, 2018) and mostly seen controverse, as it stands contrary of the principles of decentralization blockchains originated from.

Phenomena such as FOSS development, reintroduced a logic based on a gift economy rather than market principles (Benkler, 2006). A central reason for the gift economy to work was that one's use did not affect another's – facilitated by marginal replication costs, cheap computational power, and a widely-accessible network. Blockchains differ in their mode of governance from FOSS due to the mutual dependence of actors on one specific version of software at a time (Miscione et al., 2018; Miscione, Klein, et al., 2019). Consequently, the idea of developing and maintaining a shared resource – in this instance: a shared information infrastructure – emphasizes the so-called "tragedy of the commons" (Hardin, 1968) within the digital domain. The tragedy of the commons was first conceptualized in the 1840ies (Lloyd, 1833) and later became central in Nobel Laurate Elinor Ostrom's work (Ostrom, 1990) "Governing the Commons". Its underlying problem refers to a shared-resource setting, in which actors spoil the commons through opportunistic action, thus, working for own instead of shared interest. Hardin (Hardin, 1986), in his own interpretation of the tragedy of the commons, labeled such behavior as "privatizing profit and socializing losses". Possible resolutions to the tragedy of the commons refer to assigning property rights to commons, which effectively privatizes commons, top-down regulation (e.g., a regulator defines rules of using the commons per actor), which re-introduces principle-agent problems, or the development of a collective action agreement (e.g., parties agree on rules for common usage among themselves) (Ostrom, 1990).

The role of commons in blockchain-based systems is already being explored in academia by several authors (Calcaterra, 2018; Rozas et al., 2018; Shackelford & Myers, 2017): Rozas et al.

(Rozas et al., 2018) identified affordances, such as tokenization or transparentizing, brought forward by blockchain technology and discussed them against Ostrom's principles for commons governance (Ostrom, 1990), while Calcaterra (Calcaterra, 2018) explores DAOs' governance through the lens of Ostrom's principles. Shackelford & Meyers (Shackelford & Myers, 2017) study Ostrom's principles through the lens of the governance of – instead of by – blockchains.

While these works focus on rather public and permissionless blockchains, it remains unclear, if there are differences to business blockchain consortia. This is relevant, as blockchain consortia also constitute by definition a shared-resource setting in blockchain development and maintenance.

6.3 Methodology

This paper reports on findings from a project called CarCon[60], in which the authors were involved in as research partners. The research team has been involved from the project's initial idea in spring 2017 until the innovation project's end in March 2020. In this time, the research team worked on operational (e.g., business analysis) as well as strategic (e.g., founding of a legal body) matters; these tasks allowed us to gain a concise understanding on the ongoings within the projects from different perspectives, as well as the access to an extensive documentation of meeting notes throughout the project.

This research is designed as an action research following the methodology proposed by Baskerville (Baskerville, 1999) and focuses on CarCon's governance. More specifically, this research focuses on fall 2019, when it became apparent, that a more advanced governance concept for CarCon became necessary (**diagnosing**; see results section). The research team, together with practitioners, initiated a focus group (Gibbs, 1997), agreed upon a scope and project activities to be conducted by the group to evaluate the current governance concepts, where it falls short, and how it can be improved (**action planning**). Due to space limitations, within this paper, we only focus on stakeholder conflicts and proposed resolutions for these, and not on other parts of the developed governance concept. As for the first cycle of **action taking**, we applied a simplified stakeholder analysis model adapted from Smith (Smith, 2000) and Cleland (Cleland, 2004), which analyzes stakeholders along the dimensions of

[60] Please note, that CarCon had started as an innovation project, which lasted from spring 2017 until November 2019; from April 2019 on, CarCon founded the CarCon Association as separate legal body to continue the project after the innovation project ended in November 2019.

their influence on the project, each stakeholder's importance of the project, and their main interests in participating in the project. We applied this model for each stakeholder based on notes taken from in-person discussions, triweekly project meetings, quarterly meetings of the strategic committee, and the official project documentation and meeting minutes. Then (**evaluating**, cycle 1), we validated our initial stakeholder analysis with eight senior project stakeholders as part of semi-structured expert interviews conducted by a senior scholar (Myers & Newman, 2007). The set of interviewees consisted mainly of parties involved from the beginning on. During the interview, we asked every stakeholder to evaluate and argue the importance of the project, influence on the project, perceived conflicts, and interests for his respective organization but also for other stakeholders and among these. This allowed us not only to evaluate most of the stakeholders' views on their own involvement, but also to obtain valuable insights on how stakeholders viewed each other. Our interviews yielded over 12 hours of audio material, which then were transcribed and coded as a preparation for the second cycle of **action taking**. For the latter, we utilized the obtained feedback from the expert interviews for a consequent elaboration of a proposal for a to-be governance concept. As part of this (**action taking**, cycle 2), we extended our initial stakeholder analysis by categorizing perceived conflicts into conflict categories (competition, principle-agent, commons vs. privates, and regulatory conflicts), conflict areas (subcategories), conflicts, and initial proposals on how these could be dealt with (see results); this categorization related our findings to associated concepts and theories from academic literature. As this categorization is based on our empirical analysis instead of academic frameworks, it allows us to argue its relevance for blockchain consortia such as CarCon. As a last step (evaluating, cycle 2), the focus group evaluated our stakeholder analysis, derived conflicts, and proposed solutions for these conflicts. After taking obtained feedback into account and reworking our governance proposal, this engagement phase has been concluded with an official handover of our results to CarCon. This paper documents the established link of our results the theoretical contributions of our action research (**specifying learning**). Table 23. below summarizes our applied methodology.

Step	Purpose	Activity
Diagnosing	Explore problems requiring change.	Improved governance needed due to problems in practice, as seen in operational and strategic meetings; participant observation (Kawulich, 2005)

Action Planning	Collaborative action planning to resolve problems.	Research and practitioner set up a focus group (Gibbs, 1997), project scope, and project activities (constituents of governance concept as described below) to be conducted by focus group.
Action Taking	Implementing planned action in organization.	**Cycle 1:** Stakeholder analysis, review of the current governance concept, different views on governance, application of an IT governance framework, and conceptualizing a proposal of a to-be governance concept. **Cycle 2:** Rework of governance concept. Transcription of interview recordings, rough coding centering around stakeholder interests and improvements to our proposal.
Evaluating	Evaluation of outcomes of planned action.	**Cycle 1:** Evaluation with eight senior stakeholders within semi-structured expert interviews (Myers & Newman, 2007), led by a senior scholar. **Cycle 2:** Reworked governance proposal evaluation with three subject-matter experts in a dedicated focus group (Gibbs, 1997)
Specifying Learning	Deriving learnings from action taking/evaluating.	Hand-over of our practical findings to organization. Theoretical contribution worked out by research team within this paper.

Table 23. Description of our applied Action Design Research

6.4 Case Description: Towards a Blockchain within Cardossier

In the following, we first introduce the case of CarCon and its related stakeholders. Then, we show observed stakeholder conflicts and relate them to possible resolutions. Thereby, this section answers research question one and two.

6.4.1 Introduction to Cardossier: Overall Idea and Governance Evolution

CarCon was initiated in 2018 and deals with a consortium of several major stakeholders in the car ecosystem in a small European country. This consortium is led by the vision of lowering the information asymmetry between buyers and sellers of cars in the used-car market, which refers to the work of Nobel laurate Akerlof (Akerlof, 1970). To do so, as shown in Figure 5. below, CarCon is implementing a blockchain-based system to store car-related data over a car's lifecycle, from its import to its wrecking. Data, together with basic functionalities, are provided in the infrastructural layer. This infrastructure is then utilized to power so-called "dapps" (decentralized applications), which represent use cases, developed within the consortium; while the infrastructural layer and some dapps belong to the commons, dapps can also be developed by and for oneself (private). Lastly, a dapp needs to be integrated into the stakeholder's system. In general, CarCon beliefs a blockchain-based system to allow for (1) new product offerings, such as an algorithmically verified car history (CarCon dossier), (2) digitizing existing processes among members in the car ecosystem, allowing for operational excellence, and (3) higher customizability of existing products, such as individualized and automatically enforced car insurances (Bauer et al., 2020). While some of these can be realized by information/process integration among few parties, central to CarCon is the complete CarCon dossier, which can be seen as one instance of dapps. The value of such a dossier depends widely on the integrity, reliability, and completeness about information of a car (Miscione, Klein, et al., 2019)[8]. These, however, are difficult to obtain, as a car encompasses numerous actors over its lifecycle, such as insurances, state agencies, or various owners. Consequently, information about a car is structurally fragmented and maintained inconsistently, which leads to various "truths" of a car.

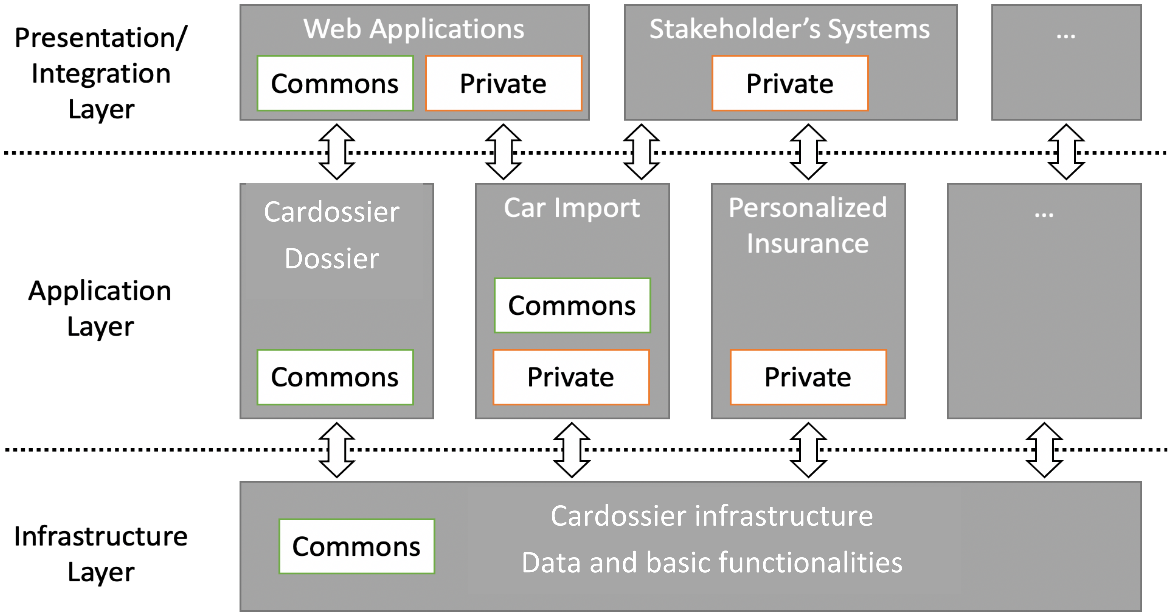

Figure 5. Overall functioning of Cardossier, adapted from Zavolokina et al. (2020)

To achieve a minimal viable car record, from the onset on, the consortium was planned to cover major stakeholder of different roles within the ecosystem. Choosing not to include competitors early on allowed us to avoid potential conflicts while maintaining pace. At the beginning, CarCon consisted of several industry stakeholders, such as a mobility service provider (CarShare), a road traffic agency (RTA), a major importer and repair shop (CarImport1), and a major insurer (CarInsurer1), who contribute their domain expertise and data to CarCon. In addition to these, the initial consortium included a large software company (ITConsult), a team of legal experts (PrivacyUni), and us as research partner (ResearchUni). CarImport2, AutoSearch, and CarInsurer2 joined the consortium shortly after its legal body was founded. Note, that several other CarCon stakeholders were not part of our analysis, as they joined either at the time of our analysis or later. Table 24 below shows an overview of the main stakeholders, which were analyzed within this research.

Stakeholder	Brief Description
CarInsurer1	CarInsurer1 covers all the car's lifecycle's processes affected with car insurance. Insurances are an essential pillar to the car eco system and frequently exchange data with other parties.
ITConsult	ITConsult is a globally operating, European-based, IT expert specializing in security and identity management. ITConsult is the main implementation partner within Cardossier.

CarImport1	CarImport1 is one of the largest car importers and inheres extensive knowledge on multiple phases on a car's lifecycle, e.g. its purchase, maintaining, and regulatory aspects.
CarImport2	CarImport2 is also one of the largest car importers. Similar to CarImport1, CarImport2 provides necessary subject-matter knowledge and car data along its lifecycle.
CarShare	CarShare is a large provider of mobility services, providing necessary insights on a car's lifecycle, e.g. its maintenance, car-related data warehousing, etc.
PrivacyUni	PrivacyUni complements the ResearchUni as research partner. With a focus on data protection and privacy by design, PrivacyUni is responsible for data compliance aspects within Cardossier.
AutoSearch	AutoSearch is one of the largest search engine and platform provider for both new and used cars. Their domain knowledge as data aggregator helps Cardossier.
ResearchUni	Research partner in Cardossier. Conducts scientific review of derived artifacts and their documentation. ResearchUni contributed to operational tasks, e.g., business analysis.
CarInsurer2	CarInsurer2 is another major insurer. Similar to CarInsurer1, CarInsurer2 provides vital domain knowledge as well as event data on insurance-related processes.
CarClub	The CarClub is one of the largest association for cars. CarClub provides a variety of services, such as support in technical emergencies or regulatory car check-ups.
RTA	The road traffic agency (RTA) regards an RTA of one of the largest regions within the country. As a regulator, the RTA covers an essential pillar of a car's lifecycle.

Table 24. Stakeholders of Cardossier (anonymized)

6.4.2 Exploring Stakeholder Conflicts within Cardossier

In the following, we explore the stakeholder conflicts within CarCon one by one along the four main identified areas of competition, principle-agent, regulatory, and commons conflicts. For each of these, we show our proposed resolutions to these.

Competition Conflicts. Cardossier's stakeholder stand in direct competition within and around Cardossier. We categorized these conflicts into market, research, and IT competition. As for market competition, several actors compete outside of Cardossier in their own respective core business (e.g., CarImport and CarImport2), others in complementary but similar product offerings (e.g., Cardossier and CarImport). To mitigate problems arising from these conflicts, we proposed several measures: (1) each stakeholder can declare conflicts of interest on a specific form, available to seen by all parties of Cardossier, which increases the transparency of a stakeholder's action. For example, CarImporter1 ran a project like Cardossier's internally and disclosed it to Cardossier early on. (2) Further, if stakeholders would fail to settle a conflict amongst themselves, a so-called fairness board allocated within Cardossier would arbitrate as a neutral third party. Thereby, it would enforce an agreed-upon code-of-conduct, comprising fundamental rules and procedures how these conflicts should be dealt with. (3) Lastly, Cardossier should allow to accommodate private (exclusive) workstreams, which allows stakeholders to work on own solutions (e.g., own, novel products or efficiency-enhancing systems).

As for research competition, two conflicts were mentioned: (1) competition on research funds offered by Cardossier or individual stakeholders (e.g., for specific workstreams) between ResearchUni, PrivacyUni, or others, and (2) the conflict of relevance for theory and practice, related to the question of what research specifically should be funded, as businesses may have limited interest in funding research without tangible, business-oriented outcomes. We proposed to tender research grants publicly within Cardossier, where research partners would compete for these. Cardossier-related research grants would then be decided within Cardossier's steering committee – funding of individual research projects is naturally subject to agreement between a research partner and the respective Cardossier member.

Lastly, competition on IT revolved around allocation of decision rights regarding development and operation of IT. These decisions rights are financially attractive, as they may result in a high dependence on one IT provider, which also benefits from gained know-how, which can then be applied to other projects. This conflict has not been prevalent within Cardossier, as we mainly focused on getting the system itself to run. For its future governance, however, to avoid being dependent on one single IT provider, we proposed to (1) install a central IT steering committee, which holds major decision rights from an architectural perspective, (2) introduce a dedicated IT partner management as an organizational function within Cardossier, which coordinates between the IT partners, and to (3) tender architectural functionalities to all IT partners to be decided upon by Cardossier.

Principle-Agent Conflicts. We observed three principle-agent conflicts, which we characterized as customer-supplier conflicts as detailed in the following. Our first observed principle-agent conflict revolves around the missing ability of members to assess IT providers in terms of their actions, e.g., system planning, development, operation, or maintenance. Complementary to the previous conflict on know-how and funds, this conflict revolves around the centrality IT providers inhere and the consequent dependence upon their judgement, i.e., how to design the overall system. Instead of putting the consortium's interest first, IT providers might be inclined to make technological choices to their benefit, e.g., to lock-in clients in their technological eco-system. We proposed to deal with this conflict with means of supervision provided by an IT steering committee, where major architectural decisions are allocated, and a dedicated technology management, which aligns all IT providers. To assure transparency of technical choices and proposals, the development of architectural functionalities (not dapps or individual solutions) should be tendered among IT providers and decided upon in the Cardossier steering committee.

Another conflict targets the provision and sharing of data itself. Naturally, several stakeholders inhere more data about a car than others, while others might depend on specific datasets to realize a desired dapp. Stakeholders can consequently be classified into being primarily data sources or data sinks. As part of a data market governance, as we propose, it is necessary to counter monopolies of data (only one party inheres data) with lowering the dependence on these parties by, e.g., relying on data from complementors, for example, car users. Of course, this is not possible in all cases.

For last, data consumers cannot assess the quality of data provided by data providers. There are several ways, how this can be handled, e.g., in compensating data provision or opening channels to report false data, or even triangulating data between more reliable data sources, as explored by Zavolokina et al. (2020). All of these are part of a dedicated data market governance, which we suggested to implement.

Regulatory Conflicts. We saw two conflict areas regarding regulatory conflicts: supervisory and sectorial conflicts. As for the area of supervisory conflicts, the RTA found itself in a conflict with CarImport, as the RTA due to antitrust law cannot favor any for-profit party over others. This necessitated full transparency of the RTA's actions and proper external communication;

if only the perception would be established, that RTA would favor a for-profit party, the RTA would have to leave Cardossier. For the same reason, referring to its sectorial conflict (public vs. private sector), the RTA can be involved in the development of dapps, but these dapps (and their corresponding workstreams) must be publicly accessible and transparent in terms of revenue. This contingency excludes RTA's involvement in promising, but private workstreams. Furthermore, state bodies can be involved in dapps targeting cost-coverage at best, but never for-profit workstreams; regulation, however, allows for surpluses, which then are gathered and redistributed within the state body. As some of these conflicts might be interpreted as inhibitors, an early alignment with regulatory entities such as the RTA legitimizes the consortium's work and, consequently, can be seen as crucial for a project's success (cf. Schwabe, 2019).

Another conflict concerned the compliance of our system with given data protection laws. Fostering this compliance has been a central reason for PrivacyUni to join Cardossier. To assess the degree of compliance of Cardossier's system, due to its complexity, PrivacyUni must rely on ITConsult's assessment, at least to a certain degree. We proposed to underline the importance of data compliance within Cardossier by a close collaboration with Cardossier's compliance function with the development, making regular compliance checks important milestones in the system development lifecycle.

Commons and Privates. The last conflict area we observed regards the division between common (shared) and private goods. A core conflict refers to the privatization of benefits, while costs are socialized. In other words: CarCon necessitates commons, e.g., a running infrastructure and basic functionalities, most of our stakeholder necessitate these, but nobody wants to pay. From a temporal perspective, stakeholders are inclined to wait for others to develop commons. Furthermore, it can be thought of that stakeholders are inclined to transfer specific functionalities for own use to the commons because there all parties would share the costs. This is especially true for in-workstream-developments and common functionalities. Every workstream entails development, adaption, or usage of CarCon's transaction layer and its functionalities or ongoing transaction-layer-specific workstreams. We proposed to deal with this conflict by developing a tax scheme, which assigns weights for usage, development, or adaption of the transaction layer and its functionalities. This would allow us to discriminate between "light" and "heavy" usage, development, or adaption to achieve a fair distribution of costs. Furthermore, it is necessary to assign the responsibility of proving the function in question to belong to the commons to the workstreams; and if this function would be commonly developed, the IP would remain with CarCon, so its usage would be taxed.

The conflict between commons and privates is also evident in the planning of the development pipeline. For example, the technology provider might develop certain features for another project of its own first, while Cardossier would need certain features earlier. We proposed to deal with this conflict by enforcing transparency between ITConsult's development pipeline as well as its pipeline for Cardossier's development; this would allow other parties to synchronize their development efforts in accordance with recent developments and, if crucial functions would have to be available earlier, the development costs could be shared. It is also necessary to steer dapp development. While parties would want to develop dapp as they like, there must be a necessary quality and commonly shared standards. We therefore proposed to deal a dapp quality management and dapp admission process, which assesses (1) technical feasibility and (2) fit with Cardossier's strategy.

For last, inhering complete and accurate record of car data is commonly desired, while individuals might omit entering or falsify data to their benefit. We proposed therefore to develop incentive mechanisms to assure data quality (Zavolokina et al., 2020a), instantiating a dedicated data quality management function, and linking Cardossier's data to Cardossier's partners' operational systems (triangulation of data).

Conflict Category	Conflict area	Conflicts (as perceived by one selves or others)	Our proposed Conflict Resolutions
Competition Conflicts Resolution: Separation of competitors in competition areas (e.g., by Platform architecture)	**Market Competition**	***Cardossier vs. CarImport:*** CarImport is involved in two similar projects. What is used for what?	**Form** comprising all conflicts of interest of each party, at the hand of the Cardossier board. **Enforced transparency** on conflicts of interests regarding all members' involvement in similar/related projects. Development of **code of conduct**, monitored and enforced by a **fairness board**. Arbitration function in case of disputes. Architecture which allows for **private** (exclusive) workstreams.
		CarInsurer1 vs. AutoSearch: Conflict due to similar products on the market.	
		CarImport vs. CarImport2: Competition outside of Cardossier	
		CarInsurer1 vs. CarInsurer2: Competition outside of Cardossier	
		CarImport Leasing vs. Multilease: Competition outside of Cardossier	
	Research Competition	***ResearchUni vs. PrivacyUni:*** Competing on research funds. (low priority)	**Steering committee** decides upon research assignments. Research requests should be **tendered** (proposal).
		Theory vs. Practice: what type of research is necessary - which research is relevant?	
	Competition on IT	***Technical development by ITConsult vs. other IT-Providers:*** Who implements what (dapps, underlying technology and infrastructure); who is allowed to host (which) nodes; competition on funds and know-how.	Introduce **IT steering committee** to plan, build, run, and manage the Cardossier system architecture. Introduce **dedicated technology partner management**, supervised by the Cardossier. After 5 years: **Tender** architectural functionalities to all IT providers; Steering committee decides.

Principle-Agent Conflicts Resolution: supervision, lower information asymmetry, incentives	**Customer-Supplier conflict**	***Data providers vs. Data consumers:*** Limited means to assess completeness of data / data quality.	**Means of supervision**. Development of data market governance.
		Economizing on a monopoly of data vs. fairness: Some members do not provide data, others provide plenty.	Partial resolution of monopolies with multiple sources of data.
		Others vs. ITConsult: Limited means to assess ITConsult‘s actions while being in high dependency	**Means of supervision**. Introduce IT steering committee to manage system architecture. **Proper incentivation**. Tender architectural functionalities to all IT providers. **Means of supervision**. Introduce technology partner management.
Regulatory Conflicts Resolution: Separation of supervisor from supervisee	**Supervisory conflict**	***RTA vs. CarImport:*** RTA cannot treat anyone better than the rest. RTA must be neutral by law and must be communicated accordingly.	**Dedicated compliance responsibility**: Clear external communication what RTA is doing with others which are subject to supervision (to prevent misconceptions)
		PrivacyUni vs. ITConsult: Limited ways to assess Cardossier's compliance with regulation	Strong data protection for **data privacy compliance**. Collaboration of data protection team with IT suppliers.
	Sectorial conflict	***RTA vs. businesses:*** RTA's (and other state authorities') membership depends on non-profit operation of Cardossier. Affects workstreams and Cardossier (there can be surpluses).	**Dedicated compliance function:** Each workstream/operation within the Cardossier where state authorities are involved has to be transparent in terms of cost and RTA's involvement (to avoid privileging)

Commons vs Private Resolution: Hybrid Ownership / Architecture, Control	**Commons vs. Private**	***Technology provider vs. Association priorities:*** Cardossier needs vs. technology providers' development pipeline	Resolution: **Control**. Enforce transparency of IT providers' and Cardossier's development pipelines (synchronization/cost sharing)
		Commons vs. Use-Case development: Workstream entails development / adaption / usage of core and its functionalities; socializing costs, privatizing benefit	Resolution: **Hybrid Ownership.** Develop tax scheme of usage / development / adaption of core and its functionalities.
		Privatize benefit, socialize cost: Businesses want to transfer functionalities they need to the core because, there, all costs are shared.	Resolution: **Hybrid Ownership.** Workstream in duty of proving the function belong to commons; usage license remains with Cardossier and usage will be taxed.
		Dapps: Freedom to develop upon one's liking vs. necessary quality and adhered to standards	Resolution: **Control.** Introduce a dapp quality management incl. an internal dapp admission process, assessing (1) technical feasibility and (2) fit with Cardossier strategy.
		Data Quality: Private interests on incomplete or incorrect data vs. common's interest on complete and correct data	Resolution: **Incentive mechanisms** for data quality, data quality management function and linking CD data to operational systems

Table 25. Simplified overview on conflict categories and areas, and possible resolutions

6.5 Discussion

The description of Cardossier has shown a case of mutually dependent actors. To answer research question three, a wider discussion follows, in which we relate our findings from the case of Cardossier to the academic blockchain governance discourse shown in the related work.

Business Blockchain Consortia and their Mode of Governance. Chapter 6.2 shows that economic activity can be accommodated in markets, hierarchies, networks (Powell, 1990; Williamson, 1975a), and outside of these (Benkler, 2017). Several authors argue that blockchain systems compete with these modes of governance, shifting agency towards algorithms (Murray et al., 2019), seeing blockchains as general-purpose technology (Davidson et al., 2016), and referring to constituents of stakeholders' mutual dependency using the analogy of 'tribes' (Miscione et al., 2018). Contrasting Cardossier's stakeholder conflicts, to which order has to be established, shows a mismatch to these. To say the least, these modes of governance do not explain Cardossier's governance regarding no clear assignment of property rights and price is not the only governance mechanism employed (contrary to markets), bureaucratic control cannot be enforced (contrary to hierarchies), there is, to a certain degree, mistrust among parties (contrary to networks), and parties are not anonymous (contrary to 'tribes') or mutually-dependent (contrary to FOSS). Rather than trying to understand Cardossier's through one governance mode, we inspect Cardossier's conflicts (table 25), which need to be 'governed', and our proposed resolutions in the following.

Inspecting Areas of Governance. Within Cardossier, we have seen several **principle-agent** conflicts manifesting as customer-supplier conflicts (see table 25). For all of these, we utilized existing literature to meet these (e.g., Isaca, 2012; Moldoveanu and Martin, 2001), relying on means of supervision, decentralization of IT and data provision, or proper incentivation. What is remarkable is that for most of these our hands were tied: we were only able to propose *structures*, which might prevent these conflicts to happen, instead of *measures* dealing with actual instances of these problems. This is because, in contrast to bureaucratic control, in a network-like setting, authority has limits, and we can narrow down agents' action spaces but hardly impose actions. For example, the development of a data market governance can incentivize good and punish bad behavior regarding data provision. However, if an actor chooses to not report data which would be harmful to oneself, there are limited mechanisms Cardossier could apply. This problem, in general, refers to the garbage-in garbage-out problem (Bateman & Cottrill, 2017), in which blockchains are valuable in persisting data but unable to assess data inputs.

As for conflicts between **commons and privates**, Cardossier constitutes an artificial material commons, where a complex system, its infrastructure, and resources are developed through peer production (Navarro et al., 2016). Creating an artificial commons, i.e. an infrastructure which not only benefits one-self, is a novel approach to business networks, in which information or process integration is frequently applied (Stevens & Johnson, 2016). Within Cardossier, we have observed several conflicts between commons and privates (see table 25). Especially the conflict between privatizing benefits and socializing costs – to which the title of this paper refers – is prominent: even though we observed several parties to inhere a good understanding of beneficiary business cases for themselves, these could not have been tried out as the necessary infrastructural layer was missing within Cardossier. Furthermore, a first mover would have had to finance commons – infrastructural functions to the benefit of everyone – on top of his own investment in the development of his dapp. Consequently, this led to a stalemate, where stakeholders wait for others to invest first. This conflict only serves as an example of the importance of culture in a network-setting, in which parties only collaborate to the degree it is beneficial for them; as a result, culture constrains strategy (Schein, 2010).

As for **conflicts on competition**, naturally, stakeholders are free to leave a business network upon their liking, which also led to a competition on business networks (Medlin & Ellegaard, 2015); in a setting of mutually dependent actors, competition conflicts can be constrained for the sake of common gains. For example, after time, several competing businesses, e.g., a second car importer, joined Cardossier. Both importers' rationale is that, despite competing for the same customers, there are value potentials, which benefit both – and eventually their customers. We observed various of such conflicts, either within (similar products as Cardossier) or outside (same business domain) of Cardossier. In addition to these, there were conflicts on Cardossier's further development, either from a research or technological side. Our proposed solutions revolved around a culture of fairness, i.e., to make conflicts of interest among parties explicit, or publicly tender any further developments around Cardossier and let elected supervisory boards decide upon best fit. We were certain these measures to tackle the inherent informal networks in a business environment (Uzzi, 1997). Consequently, the decentralization of major decision rights within Cardossier has been central to the revisited governance concept in the second cycle of our action research.

For last, **regulation**, in the sense of local laws and their application, have frequently been cited as a detriment to blockchain adoption (Lacity, 2018). Consequently, collaborating with regulatory entities, Cardossier has shown, how working alongside regulators can enhance Cardossier's success (Schwabe, 2019). At the same time, the collaboration with regulatory entities shaped Cardossier's structure and operations, as regulatory entities cannot favor single parties over others, while their actions must be transparent, which effectively make them unsuitable contributors to a business' private workstream. For last, because of many questions in the form of their collaboration, Cardossier serves as an example of how regulatory functions, such as our proposed fairness board, compliance function, or business/IT steering committees are a result of a common regulatory process in the very sense of commons governance (Ostrom, 1990), and how these were institutionalized in an own legal body, the Cardossier association.

Building Common Ground. All of these conflicts require own rules, on how they can be dealt with. Aside from these, there must be a rule-setting entity, which not only specifies these rules, but also provides rules for changing these rules, if need arises. Furthermore, such an entity must also define the overall structure, e.g., which conflict is being dealt within which realm or by which process. For most of these matters, within Cardossier, the Cardossier association has been responsible, providing common ground among its stakeholders. For some of these questions, counterintuitively, DAOs, can be helpful: to at least partly overcome opportunistic actions, hence, narrowing down an agent's action space, DAOs encode various governance operations, such as decision-making or changing its underlying ruleset, "on-chain" utilizing smart contracts (DuPont, 2018). This is necessary, as actors in such blockchains tend to stay pseudonymous (Miscione et al., 2018), which would entice opportunistic behavior, to which immutable smart contracts are a solution. But even in these systems, smart contracts cannot account for the formal and informal networks with "off-chain" procedures (Ziolkowski et al., 2020b), which render smart contracts unnecessary. It is common among public blockchains to found legal bodies as point of reference to their communities (e.g., Bitcoin's or Ethereum's association). In addition to these, to assure that conflicts are met adequately, it is also common to provide meta-structures of governance, which accommodate different kinds of decisions in different boards, e.g., in organizational or technical boards (e.g., Tezos, 2020), which is a similar approach has been part of our work within Cardossier.

6.6 Conclusion

This paper studies business blockchain consortia governance by examining stakeholder conflicts and possible resolutions to these from a project we were involved in. Consequently, we discussed our findings against blockchain governance literature and distilled several discussion points, which enhance our understanding of agency, regulation, commons, and competition within business blockchain consortia.

As with every research, our research is not free from limitations. First and foremost, even though we were part of CarCon since its inception for over three years, our research shows a snapshot of stakeholder conflicts at one point in time. This is also due CarCon's significant growth from initially 9 parties to over 22 and counting. Even though we are certain cover central stakeholder conflicts, it can be expected, that these new parties will bring new or alter stakeholder conflicts within CarCon. Furthermore, we cannot ensure the generalizability of our findings. We are confident, however, that CarCon resembles several features from a commons-based blockchain consortium, which, at the very least, stands for a class of blockchain consortia.

We see several future research opportunities. First, it would be promising to study the areas of principle-agency, commons, competition, or regulation on other blockchain consortia in more detail, especially, regarding how consortia dealt with these. Thereby, studying a consortium over time, with problems and their resolutions in practice, would yield greater detail in which resolutions work and which resolutions are altered by blockchain technology. For another, our findings in CarCon, but also several other business blockchain consortia we are currently studying, show a gap between on-chain functionalities, such as on-chain voting or resource allocation, which DAOs are heavily trying out. Understanding, when to encode which functionality, and criteria for these, might lead to a better understanding on both governance *of* and *through* blockchains.

Part III: Studying Blockchain Consortia

7 PAPER VI: Why Blockchain?

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Abstract

Despite the large number of resources that blockchain has, and continues to mobilize, it is not yet fully understood what makes the technology unique and why people engage with it. Hence, *"Why Blockchain?"* is a question that many scientists and managers still ask themselves or have to answer when facing the technology's critics. While the question is undoubtedly justified, it cannot always be answered from a purely technical perspective. Thus, in this study, we apply a socio-technical IS artifact perspective and analyze the reasons managers involved in blockchain consortia have for using blockchain technology. Based on a multiple-case study of 19 blockchain consortia, including interviews with 53 stakeholders, we explicate 19 different motives that justify engagement with the technology in practice. Further, we identify the systemic character of *tokenization* and the importance of the socio-technical interplay of aspects like power decentralization that justify the necessity of blockchain.

Acknowledgments

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7.1 Introduction

Blockchain technology has been impacting our society for over a decade now. In doing so, blockchain technology has come a remarkable way, from a niche technology with few adoptions to trillion-dollar global information infrastructures in the form of cryptocurrencies (CoinMarketCap, 2020). However, the technology is also being tried out in various application domains aside from cryptocurrencies. We have seen businesses forming consortia and applying blockchain technology to use cases, among others, in the energy sector (Mengelkamp et al., 2018), the automotive sector (Notheisen et al., 2017), and the health sector (Angraal et al., 2017).

Yet, it is not fully understood what makes blockchain so unique and why people engage with it. This makes it difficult for both practitioners and researchers to judge the necessity and relevance of blockchain information systems (blockchain ISs). As with other "experimentations at the edge" (Venkatraman, 2017), both managers involved in blockchain projects and researchers of blockchain ISs often get held up in their work, having to re-evaluate and legitimize their choice of technology (Angelis & Ribeiro da Silva, 2019). This situation, from a practical point of view, not only leads to innovation project delays but sometimes even project shut-downs as some managers themselves do not understand the necessity of blockchain or cannot communicate it clearly to their superiors. Besides that, from an academic perspective, research that goes beyond mere technical evaluation of the technology or the technology's applicability to a specific use case often faces the challenges of having to legitimize the necessity of the underlying blockchain for its analyses.

Although the applicability of blockchain technology continues to be debated in research and practice, the hype around blockchain is real insofar as it mobilizes resources in practice (Miscione et al., 2020) and, therefore, constitutes a new phenomenon (Du et al., 2018). Reasons for dealing with this new phenomenon – and, more specifically, choosing blockchain technology – have so far been limited to blockchain's narrative of decentralization and disintermediation that come wrapped in various decision trees (Betzwieser et al., 2019; Wüst & Gervais, 2017), for example. Thus, it is now time to revisit blockchain as a socio-technical phenomenon from the perspective of those who engage with it. Studying practitioners' motives for using blockchain and its legitimizations in practice, we aim to shed light on the often-asked question "Why Blockchain?" and thereby explicate the particular characteristics of this novel type of inter-organizational system (IOS) (Seebacher & Schüritz, 2019). Hence, we raise the following research questions:

RQ1: What are the motives of business consortia members for using blockchain technology?

RQ2: What makes blockchain unique to justify engagement with it?

As blockchain advocates claim the ambition of the technology to change the world, a purely technical analysis is not sufficient. Rather, a socio-technical perspective, which lies at the heart of the information systems discipline, is needed. In essence, a socio-technical view regards equal relevance to both the technical and social aspects of a system from which information arises and impacts the socio-technical interaction (Briggs et al., 2010; Sarker et al., 2019). The paper of Chatterjee et al. (2020) provides a conception of an IS artifact that integrates these key elements and their interaction. It allows the opportunity to structure the motives from a socio-technical perspective and, consequentially, to explicate and theorize on the information system's unique properties. Thus, in this study, we apply this reference model, which will be explained in detail later (Section 7.2.1), to business blockchain consortia.

For the empirical basis, we conducted a multiple-case study with business blockchain consortia, which are consortia that focus on business problems (e.g., the cardossier consortium (Zavolokina et al., 2020b)), instead of blockchain technology development consortia, such as Corda or Hyperledger. For this multiple-case study, we conducted 53 interviews with two to four interviewees from 19 different business blockchain consortia from various domains. The results provide rich insights into 19 different motives businesses have for using blockchain technology. Besides that, by contextualizing these motives along with the IS reference framework of Chatterjee et al. (2020), and analyzing their development over time, we find that in early exploration phases, the motives of businesses for dealing with blockchain technology are comparable to adoption motives for other IOS technologies. However, as soon as the uncertainty about technological innovation decreases, technological-, social- and information-driven motives emerge that distinguish blockchain from other IOS technologies.

This research has various contributions. Applying an empirical analysis that moves beyond a single case study analysis, this research contributes to prior research a deeper socio-technical understanding of blockchain as a phenomenon, rather than providing yet another normative description of the technology. This is relevant for both academics and practitioners. Academics can build on the theoretical conceptualization of blockchain as a socio-technical system and move beyond purely technical analyses. Besides that, by explicitly granting the IS artifact a theoretical role, we pave the way for future more substantial research on the effects of blockchain IOSs (Robey et al., 2008). Practitioners can benefit from a detailed description of other practitioners' motives and learn about the unique aspects of the technology they should aim to target and leverage. Besides that, they can use the synthesized blockchain IS motives for their following legitimization challenges.

The remainder of this paper is structured as follows: first, we introduce the IS artifact reference framework of Chatterjee et al. (2020) that guides our study. Next, we introduce blockchain information systems and review prior work on motives to engage with and develop blockchain information systems, as well as motives for IOS adoption. After that, we describe how the data was collected and analyzed. Then, we present the results and subsequently discuss the results in light of prior academic work. Finally, we conclude the paper by pointing out limitations and directions for future research.

7.2 Related Work

7.2.1 A Sociotechnical IS Artifact Perspective

The socio-technical perspective is often described as the distinctive and coherent foundation of the information system's discipline (Sarker et al., 2019). It regards equal relevance to both the technical artifact and the tasks and structures of the group of developers and users of the artifact in the social context. Besides that, information is regarded to impact and be impacted by this socio-technical interaction (Sarker et al., 2019), and the outcomes are described as the results of the interaction between these two central systems (Briggs et al., 2010). To help researchers practically apply a socio-technical perspective and structure their research, the use of an IS/IT artifact is often proposed (Akhlaghpour et al., 2013; Benbasat & Zmud, 2003). However, many IS/IT artifact conceptions today lack the very essence of our discipline, namely information (Hassan, 2011; Mingers & Standing, 2018). Yet, especially today, with the growing relevance of information in areas such as artificial intelligence, blockchain, and big data (Agarwal & Dhar, 2014), a proper understanding and analysis of the information element is essential. Addressing this research gap and aiming to help researchers practically apply a socio-technical IS perspective, Chatterjee et al. (2020) introduced a theoretical conception of an IS artifact, thereby granting information an explicit role (Figure 6). This conception of an IS artifact follows the notion of the socio-technical view, and even more concretely integrates and explicates the role of *information*. While general agreement exists that next to the interaction of the social and technical ends, information represents a central element of the IS field, it has so far mainly been neglected or not addressed adequately given its importance. In line with prior research (Nunamaker et al., 2015; Nunamaker, Jr. & Briggs, 2011), however, Chatterjee et al. (2020) argue that even if technologies might fade or get exchanged, information persists and is gaining increasing relevance that needs to be adequately addressed.

Figure 6 below represents the reference model, which serves as a compass for this research. Its elements are explained in more detail below.

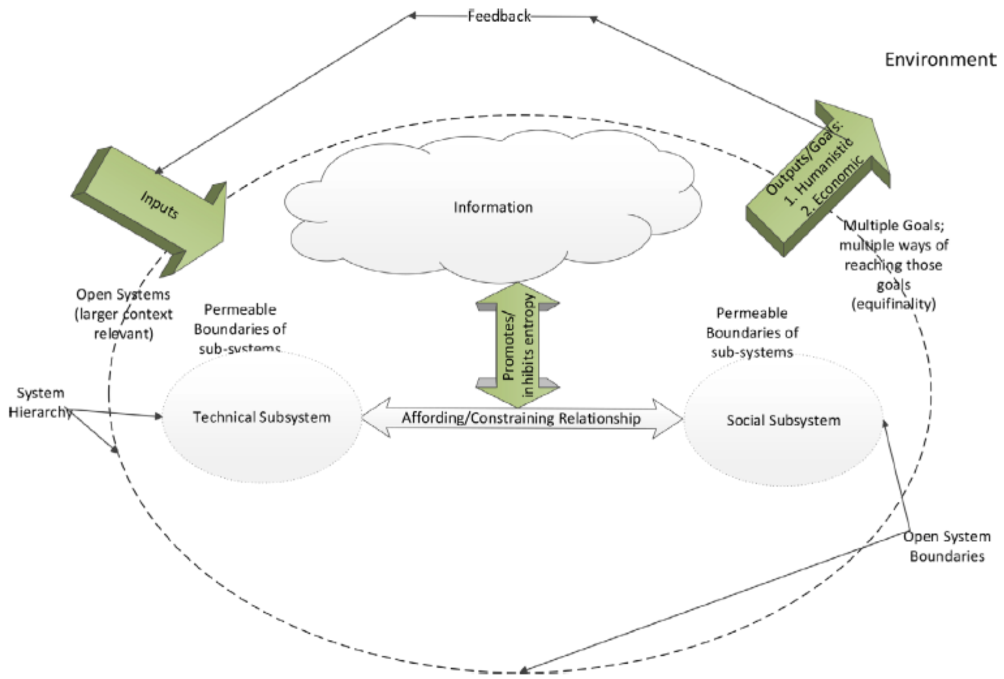

Figure 6. A reference model for an IS artifact (adopted from Chatterjee et al. (2020))

The core components of the reference model are the technical subsystem (i.e., the necessary techniques, tools, and systems that enable us to transform inputs to outputs to enhance organizational performance) and the social subsystem (i.e., the individual actors or groups, their knowledge, skills, the structures, and their relationships, etc.), as well as the information that shapes and is shaped by the interaction of the two subsystems. While the social and technical subsystems are in an affording/constraining relationship with each other, information is positioned as "*a defining and emergent property of the superordinate system that shapes, and is shaped by, how the social and technical subsystems interact.*" (S. Chatterjee et al., 2020, p. 7). Thus, information is a fundamental systemic character of the interaction of the social and technical subsystems and can play multiple roles (Henfridsson & Bygstad, 2013). It can be a medium, a mediator, or an outcome of the interaction of the social and technical subsystems. Regardless of its role, its fundamental salience is to reduce entropy (i.e., the level of uncertainty and disorder in the system) (G. A. Swanson et al., 1997). While both high and low entropy are beneficial, it is important to note that they produce different outcomes. When entropy between the social and the technical subsystem is high, subsystems find innovative ways to reduce entropy and thus create innovations. In contrast, *"when* *entropy is low, subsystems work in tandem and produce outcomes"* (S. Chatterjee et al., 2020, p. 11).

Further, as represented through the dashed lines, the subsystems are malleable and interact with the surrounding and changing environment and potentially, with other subsystems. Finally, represented at the top of the model, the feedback loop emphasizes an IS artifact's dynamic nature and the exchange with the environment through receiving inputs and producing outputs. More precisely put, it allows information to be fed back regarding the system's output as new input, which might lead to changes in the transformation process affecting subsystems and/or information.

Having introduced the reference IS artifact and the particular relevance of information, we now turn our attention to blockchain information systems and business consortia and how the introduced IS conception of an artifact can help us to structure and understand their motives for using blockchain.

7.2.2 Blockchain Information Systems and Business Blockchain Consortia

While the promises of blockchain for businesses and society have led to innumerable prototypes, the choice of blockchain technology has not always been reasonable (Betzwieser et al., 2019). In layman's terms, blockchain technology relies on the principles of decentralization, auditability, persistency, and pseudonymity (Thakur et al., 2020; Zheng et al., 2017a), and blockchain systems are essentially regarded as decentralized record management systems (Beck et al., 2017). Blockchain information systems, addressing business problems, are often initiated as collaborative projects in so-called business blockchain consortia (Zavolokina et al., 2020b). In a blockchain consortium, different organizations join forces to develop, manage, govern, and operate a shared blockchain information system (O'Leary, 2017). Such shared systems can be understood as a class of IOS, namely, systems facilitating electronic exchanges and interactions between two or more participating organizations (R. Chatterjee, 2017; Robey et al., 2008). Previous forms of IOS include systems for information integration, using, for example, EDI, or processual integration using, for example, collaborative planning, forecasting, and replenishment (CPFR) (e.g., Romero & Vernadat, 2016).

In contrast to prior IOS technologies, blockchain allows the involved parties to decentralize control and management of the IOS (Zavolokina et al., 2020b). Even though its context is different, the same line of thought has been applied to the fundamental example of Bitcoin, where the choice for the technology – or better said, the drive for the technology innovation –

was very much driven by exactly this economic desire for decentralization of power and control (Nakamoto, 2009), that has so far not been possible. Besides that, blockchain ISs differ from prior inter-organizational exchange systems and standards, like EDI, in that they allow the opportunity to assure the uniqueness of the stored records and, hence, create "ownership of data" (Miscione et al., 2018). Thus, blockchain information systems provide the opportunity to manage unique digital data in a distributed and decentralized setting.

As the mode of collecting and managing data changes and the role and value of data also changes, the above-introduced conception of an IS artifact (that grants an equal role to technical and social aspects and makes the role information explicit) is uniquely well suited to structure prior work and serve as a theoretical basis for analyzing motives of members of business blockchain consortia to engage with and develop blockchain information systems.

7.2.3 Motives for Engaging with and Developing Blockchain Information Systems

Reviewing research on blockchain technology, we find that reasons for choosing and dealing with blockchain technology have so far mainly been addressed by drawing on blockchain's technical characteristics mentioned above (i.e., to analyze the technical subsystem). Many researchers draw upon these characteristics and derive questions for decision-makers that help them evaluate the appropriateness of the technology for their businesses (Betzwieser et al., 2019). The work of Koens & Poll (2018), for example, helps to delimit the use of blockchain from related technologies such as shared central databases. Meunier (2018) provides an overview of a variety of decision models (DMs) (largely from grey literature), again aimed at supporting decision-makers to assess the appropriateness of blockchain mainly from a technical perspective, which is in line with the work of other researchers (Belotti et al., 2019; Chowdhury et al., 2018). Wüst & Gervais (2017) provide a tool to assess the technical necessity of blockchain as well as the fit of specific instantiations (i.e., private vs. public, permissioned vs. permissionless). Finally, Betzwieser et al. (2019) and Pedersen et al. (2019) make the first attempt to integrate parts of the social subsystem (multiple parties with conflicting interests) into blockchain decision models. However, they either position these as prerequisites (e.g., multiple parties that do not trust each need to be involved) rather than granting them an equal role (Betzwieser et al., 2019), or they do not separate the technical from the social aspects (Pedersen et al., 2019). This makes it hard for decision-makers to understand the interrelationship of the social and technical subsystems and the actual value of the social subsystem. All in all, we find that while these DMs support businesses in their evaluation and decision-making regarding the technology, they largely only focus on the technical subsystem and neglect its interrelation with the social subsystem, and especially with the information element.

Consequently, the variety of blockchain initiatives and systems cannot be fully understood by these decision models that largely focus on technical aspects alone. Thus, we also reviewed research that analyzes and reports on the use of blockchain to understand what motivates practitioners to engage with the technology. Focusing on supply chain management, Müller et al. (2020), for example, find that blockchain is adopted to foster trust and reduce uncertainties and vulnerabilities in collaborative business processes. The works of Seebacher & Schüritz (2019), Dozier & Saunders (2020), and Kostić & Sedej (2020) highlight blockchain's ability to facilitate decentralized inter-organizational collaboration (i.e., collaboration that does not require a central authority). Consequently, the need for controlling partners, which is inversely related to trust (Gallivan & Depledge, 2003), might no longer be necessary. Further, research on blockchains as IOSs in supply chains shows how various tensions among associated parties define the eventual blockchain IS (Sternberg et al., 2020). Eliminating dependencies on a central authority and third parties through blockchain adoption is also considered to be an opportunity to establish "digital trust" between the involved actors (Beck et al., 2016), for example, in land titling in India (Thakur et al., 2020). Zavolokina et al. (2020) go even further and argue the need for collaboration and sharing of power as the key economic rationale for the consortium's choice of blockchain. Lastly, the ability to create common goods is another theme that arises (Cila et al., 2020).

Besides the social subsystem, some researchers also mention the use of blockchain to tokenize assets of high value (Notheisen et al., 2017). These range from medical records (Liu, 2016) and trusted car data to represent a car's life cycle digitally (Bauer, Zavolokina, & Schwabe, 2019) to crypto art (Franceschet et al., 2019). Essentially these researchers report on the necessity of blockchain technology as it changes the value of information (O'Dair, 2019) by making data unique and creating some form of ownership (Miscione et al., 2018). While this could be positioned as a motive to develop blockchain ISs in the information element, a clear classification and understanding of this motive from a practitioners' view have been missing so far.

Finally, prior research shows that, in fact, many blockchain consortia do not have a final blockchain system in mind when they start. They are rather driven either by the desire to experiment and learn about the technology (e.g., input) (Du et al., 2018), or by business goals (i.e., the output) (Bauer et al., 2020). For example, on the one hand, many aim to move beyond blockchain applications in the financial sector by learning-by-doing and experimenting with it (Ehrenberg & King, 2020). On the other hand, Bauer et al. (2020) show that businesses in the car ecosystem are largely driven by the goal of increasing efficiency, creating product innovations, or customizing products and services. Another example is the case of land registries, where such blockchain systems are driven again by efficiency goals through inter-jurisdictional record integrity and security (Lazuashvili et al., 2019). However, specific configurations of such systems have not been detailed yet. Rather, multiple possible configurations of such systems are generally possible. Similarly, in the case of inter-organizational collaboration in the container shipping industry (Jensen et al., 2019), blockchain was adopted to improve operational efficiency and reduce costs.

All in all, this review indicates that prior research to specifically address motives to engage with and develop blockchain information systems so far has mainly focused on the technical subsystem. Besides that, reviewing these prior works on decision models that aim to support practitioners, we find that they largely apply a top-down approach. In that, the decision models are developed and described based on general insights about the potential of the technology. Yet, a bottom-up view, from the perspective of practitioners that engage with the technology, is lacking. As presented above, research reporting on the use and development of blockchain information systems in practice indicates that other motives to use blockchain that touch upon the *social subsystem*, *input* and *output,* and information exist. Yet, an in-depth analysis of the these motives and their interrelation is missing. Thus, in what follows, we review IOS adoption motives. In this regard, we have to acknowledge that "adoption motives" do not equal "motives for engaging and developing a (blockchain) information system." As such, "adoption" implies that companies decide to use a ready-made system. However, in terms of blockchain information systems, up until now, adoption hardly occurs since only very few consortia have indeed launched a completed system and started onboarding new companies. Interestingly, with regards to IOSs in general, the literature focuses, with few exceptions (Volkoff et al., 1999), on adoption rather than the (collaborative) building of such systems. We reason that most IOS initiatives were mainly driven by a focal firm, and then later adopted by others (e.g., suppliers) (A. Kumar et al., 2020). In the absence of a dedicated stream of literature on building IOSs, we rely on the literature on IOS adoption motives to see if it can provide further insights and directions for analysis, especially with regard to the so far neglected elements of the social subsystem, information, and input/output. As such, we assume that motives of blockchain consortia members to engage with blockchain can still be related to this literature stream (the final goal of such initiatives being adoption), even though IOS adoption motives may reflect a later stage.

7.2.4 IOS Adoption Motives

IOSs are a class of systems supporting various kinds of inter-organizational processes by allowing members of different organizations to access and exchange information. Examples of technologies representing the *technical subsystem* of the IS artifact (Chatterjee et al., 2020) used in IOS implementations include databases, EDI systems, XML, workflow systems, and group decision support systems. As such, motives for adopting and using a particular technology will depend on the purpose of the intended IOS and the processes that it should support. Building on previous work by Kumar & van Dissel (1996), Chi & Holsapple (2005) differentiate between pooled information resource IOSs, value/supply-chain IOSs, and networked IOSs. Pooled information resource IOSs allow for the exchange of structured information and include common information repositories (e.g., shared databases) and common communication infrastructure (e.g., based on XML or peer-to-peer communication). Value/supply chain IOSs are based on EDI systems allowing joint forecasting and planning or RFID sensors to track shipments, for instance. Networked IOSs can be understood as shared collaborative spaces, such as forum-like applications or video-conferencing. In general, the appropriateness of technical system will hence be assessed by considering the intended type of IOS and the requirements resulting from a specific use case, for example, in terms of flexibility, scalability, real-time access, available role concepts, configurations for interface design, and access control and security mechanisms.

In terms of the *social subsystem* (Chatterjee et al., 2020), previous works provide several reasons for companies or a group of companies to engage in an IOS initiative that is not purely dependent on the characteristics of a certain technology. These can be for example: contingencies influencing the setup of consortia or their choice of technology (Danese, 2011; Orlikowski, 2010), project and resource spaces (Benkler, 2006), but also collaborative patterns among companies' (Chi & Holsapple, 2005a; Robey et al., 2008), e.g. inter-organizational processes along with different steps of a supply-chain. As such, IOS adoption motives (Chi & Holsapple, 2005) include the *asymmetry motive* (to adopt an IOS to exert power or control other companies), the *reciprocity motive* (to adopt an IOS to collaboratively work towards mutually beneficial goals), or may relate to the characteristics of inter-organizational *transactions* (e.g., in terms of their frequency). In addition, *organizational readiness* (e.g., in terms of available financial resources and top management support) of individual firms influences IOS adoption (Robey et al., 2008).

In terms of the *information* element of the IS artifact (Chatterjee et al., 2020), the sharing of information across organizational boundaries (i.e., between organizations) to execute inter-organizational processes is at the core of IOSs. Depending on the type of IOS (see above, Kumar and van Dissel, 1996), IOSs may be used to exchange structured, semi-structured, or unstructured information. Requirements related to information that may influence companies' decisions to adopt an IOS (Chi & Holsapple 2005) may relate to *information transparency* (which information should be shared, and with whom), *information quality* (which transactions should be allowed/not allowed to ensure validity and utility of the system), *information privacy/confidentiality* (how to avoid misuse and stealing of information), and *information access and symmetry* (how to make sure that users of a system have the same level of information and avoid opportunism).

As for *input* from the environment (Chatterjee et al., 2020) that motivates companies, or creates pressure on companies to adopt IOSs, prior work by Chi & Holsapple (2005) distinguishes between the *necessity motive* (to adopt an IOS to meet regulatory or legal requirements), the *agility motive* (to adopt an IOS to become more agile and better able to deal with environmental changes), the *stability motive* (to adopt an IOS to decrease environmental uncertainty and to achieve more stable relationships with partners), and the *legitimacy motive* (to adopt an IOS to comply with external norms, expectations, and practices in an industry). Also, *culture and institutional forces* (e.g., institutional and inter-organizational trust, mimetic pressures) (Robey et al., 2008) operating within inter-organizational networks have been found to influence adoption. At the level of individual firms, the *characteristics of an IOS innovation* (e.g., compatibility with existing systems, cost) may influence the intention to be involved in and adopt an IOS (Robey et al., 2008).

Finally, Chi & Holsapple (2005) identify several motives that relate to the *outputs/goals* (Chatterjee et al., 2020) associated with adopting and using an IOS from the perspective of a group of companies. This includes the *efficiency motive* (to adopt an IOS to increase efficiency within individual companies and the efficiency of inter-organizational collaboration), the *innovation motive* (to adopt an IOS to innovate and create value), and anticipated (positive) *network externalities* (Robey et al., 2008), such as the expected size and coverage of a network of organizations using an IOS.

All in all, the findings of prior work presented above provide an overview of IOS adoption motives in general, which will serve as a frame of reference for discussing the findings of the empirical analysis. They will hence be helpful to compare motives of consortia to build blockchain ISs, as a class of IOSs, with IOSs in general, as well as to place motives of blockchain consortia within the context of IOS research.

7.3 Data Collection and Analysis

Mainly postulated by Glaser & Strauss, (1967), grounded theory (GT) is a method applied in qualitative research that aims to develop theory that is grounded in systematically gathered and analyzed data (Urquhart et al., 2009). It is well suited for research that aims to explore and understand information systems phenomena and theorize about them (Goulielmos, 2004). More specifically, Wiesche et al. (2017) differentiate between three valuable outcomes of GT methods, applied in information systems: theory development, model development, and rich descriptions of a new phenomenon. Thus, as the goal of this research is to (1) understand and thoroughly describe blockchain as a new phenomenon, as well as (2) define relevant variables and relationships in a blockchain IS (i.e., model development), GT is a uniquely well-suited method for this study. To support IS researchers in conducting and evaluating grounded theory studies in ISs, Urquhart et al. (2009) proposed five guidelines (p. 369): (1) *constant comparison* (constantly comparing instances of data labeled as a particular category with other instances of data in the same category); (2) *iterative conceptualization* (i.e., theory building by using iterative theoretical coding); (3) *theoretical sampling* (deciding, on analytical grounds, where to sample from next); (4) *scaling up* (grouping higher-level categories into broader themes); (5) *theoretical integration* (relating the theory to other theories in the same or similar field). In the following, we explain the grounded data collection and analysis process and show how we followed the proposed guidelines.

7.3.1 Data Collection

Theoretical sampling started very early in the process. Before the core large-scale multiple-case study, we were engaged in a blockchain business consortium for over two years. Thus, through the course of this single-case study, we gathered some general insights about why businesses in the consortium decided to engage with blockchain. However, to extend the scope and gain comprehensive insights into the motives of businesses who are engaged in a consortium for employing blockchain technology, we adopted a multiple-case design and performed a cross-case analysis (Cavaye, 1996; Yin, 2009). Cross-case analysis allows opportunities to gain rich insights and increase the validity and generalizability of exploratory findings (Eisenhardt, 1989b; Yin, 2009). Further, it allows for recognizing cross-case patterns that are domain-independent and go beyond single-sided impressions (Eisenhardt, 1989b). This is important as the goal of this research was to explore general rather than domain-specific motives for engaging with and developing blockchain ISs. Initially, we intended to interview ten business blockchain consortia, including the consortium that motivated this study. However, as the data revealed novel insights, we decided to continue data collection of the same data group (*theoretical sampling*) and conducted additional interviews until saturation was reached. We hence stopped collecting further data after having interviewed nine business blockchain consortia. This led to a total of 53 interviews conducted with 19 consortia and focused on grounded analysis.

The interviews, regardless of the phase they were conducted in, all followed the same semi-structured approach (e.g., Hopf, 2012, p. 350). The interviews were conducted with individuals that were involved in a blockchain consortium and included questions related to the value creation approach, technical aspects of the blockchain solution, collaboration and governance in the consortium, as well as questions regarding legal and regulatory issues. To gain complementary insights into each consortium, we conducted at least two interviews per consortium (*theoretical sampling*). To be eligible, interviewees that were selected needed to belong to different member firms of a consortium and have different competencies in the consortium (e.g., consortium management or blockchain system implementation). Conducting interviews with several persons per consortium also allowed us later, during analysis, to cross-validate and contrast individual statements within a case (*constant comparison*).

For the recruitment of consortia, we aimed at covering various industries to gain insights independent from specific industries. In addition, we focused on consortia aiming to build a blockchain solution to address a business problem (as opposed to consortia developing technological infrastructure only, e.g., Corda). Table 26 gives an overview of the final sample, including each consortium's industry, source of funding, year of foundation, and the roles of the interviewees' companies in the consortium. The interviews were conducted over 6.5 months, from February to September 2019, including interviews with the business blockchain consortia that motivated this larger cross-case analysis. Interviews were held in German or English and either face to face or using video-conferencing software. The length of the interviews ranged between 29 and 100 minutes. The recordings were transcribed verbatim.

Consortium	**Industry**	**Funding**	**Founded**	**Interviewees**
C01	Mobility	Public	2017	C01_I01: Academic partner C01_I02: Business partner C01_I03: Public agency C01_I04: Technology partner
C02	Financial services	Public	2016 (-2017)	C02_I01: Technology partner

				C02_I02: Business partner C02_I03: Technology partner
C03	E-government	Public/ Private	2016	C03_I01: Business partner C03_I02: Legal consultancy C03_I03: Technology partner C03_I04: Legal consultancy
C04	Pharmaceutical	Private	2017	C04_I01: Technology partner C04_I02: Business partner C04_I03: Business partner
C05	E-commerce/ logistics	Private	2018	C05_I01: Business partner C05_I02: Technology partner C05_I03: Business partner
C06	Energy	Public	2018 (-2021)	C06_I01: Academic partner C06_I02: Technology partner C06_I03: Business partner
C07	Logistics	Private	2016	C07_I01: Technology partner C07_I02: Business partner C07_I03: Business partner
C08	Health care	Public	2016 (-2019)	C08_I01: Coordinator C08_I02: Technology partner C08_I03: Legal consultancy C08_I04: Business partner
C09	Trade finance	Private	2017 (-2018)	C09_I01: Business partner C09_I02: Business partner C09_I03: Business partner
C10	Health care	Private	2018	C10_I01: Business partner C10_I02: Business partner C10_I03: Business partner
C11	Pharmaceutical	Private	2016	C11_I01: Technology partner C11_I02: Technology partner
C12	Financial services	Private	2017	C12_I01: Business partner C12_I02: Technology partner

C13	E-government	Private	2016	C13_I01: Technology partner C13_I02: Technology partner
C14	Food supply chain	Private	2018	C14_I01: Technology partner C14_I02: Business partner
C15	Financial services	Private	2019	C15_I01: Business partner C15_I02: Technology partner C15_I03: Business partner
C16	Energy	Public	2018	C16_I01: Business partner C16_I02: Academic partner
C17	Trade finance	Private	2018	C17_I01: Blockchain platform C17_I02: Business partner C17_I03: Business partner
C18	Mobility	Public	2017	C18_I01: Business partner C18_I02: Academic partner
C19	Trade finance	Private	2017	C19_I01: Blockchain platform C19_I02: Business partner

Table 26. Sample of blockchain consortia

7.3.2 Data Analysis

The grounded analysis consisted of three steps, each of which was developed iteratively.

During the first step, we applied an open coding process (Saldaña, 2009) and searched bottom-up for the motives of businesses to engage with and develop blockchain information systems. For analyzing the interview material, qualitative data analysis software (MAXQDA) was used. The resulting code units were mainly phrases and sentences (Weber, 1990). Two researchers were involved in the coding process, in which we established common grounds on motives to use blockchain technology on the initially collected dataset (C01-C10) by *constantly comparing and contrasting* the emerging code units of a particular category. Thereafter, one researcher coded the remaining transcripts (C11-C19) to validate and possibly extend the preliminarily identified motives *and* check whether saturation was reached. Also, during this phase, the researcher again compared and contrasted the labeled text sequences that emerged in a category from the second parts of the transcripts, with prior coded text sequences from the first parts of the transcripts to ensure consistency (*constant comparison*). Upon completion, the results were discussed and refined iteratively within the research team.

To also include external feedback, a workshop with collaborators of the study team was conducted to discuss and review the results.

During the second step, we focused on *iterative conceptualization and scaling up*. More specifically said, for sensemaking, we applied a top-down approach guided by the IS artifact reference framework of Chatterjee et al. (2020). For this, first, one researcher revisited the codes in the context of the interviews and paid special attention to contextual factors along with their explanation, such as reasoning of the motive (e.g., "to achieve business/strategy *goals*", or "to achieve *external* publicity"), that were in line with the definitions of the elements and subsystems of the IS artifact reference framework. This enabled the researcher to map the motives along with the elements and subsystems of the IS artifact reference framework. Besides that, special attention was paid to common themes among the motives mapped to the elements and subsystems of the IS artifact reference framework, which allowed the opportunity to group the motives to higher-level theoretical themes. The results of this mapping and grouping were then discussed and refined within the research team. Thus, we went beyond data labeling and presenting the emerging code units by revisiting codes in context (*iterative conceptualization*), and mapping and grouping them to higher-level theoretical themes (*scaling-up*).

Finally, during the third step, we again applied *iterative conceptualization* and *scaling up*, however, to move towards *theoretical integration* in our discipline. Thus, we again revisited our data, but now focused on contextual meta-information that provided insights about the development and relevance of the motives. For this, we analyzed the higher-level group of motives in a broader context of the interviews and considered contextual meta-factors such as time (i.e., the project phase that the interviewees described) and the tone that the interviewees used (i.e., strong emphasis of motive or rather supportive arguments). Thus, rather than focusing on the specific instantiation of the motives (e.g., whether experimenting or opportunity-seeking) we analyzed how the groups of motives (e.g., technology innovation) were described in the context of the project development. Finally, as we will present in the discussion section, this middle-abstraction level allowed us to theorize on the characteristics unique to blockchain ISs and discuss and position our resultant theory in the context of blockchain, and IOS theories (*theoretical integration*).

7.4 Results

In the following subsections, we present the iterative development of our results. First, we show the motives that emerged from the bottom-up open coding process. Second, we present the mapping and grouping of the empirically emerged motives to higher-level theoretical themes along with the IS artifact reference framework of Chatterjee et al. (2020). Third, we show our findings regarding the development and relevance of the group of motives, along with explanatory codes from our contextual meta-analysis which eventually enabled us to develop grounded theory.

7.4.1 Grounded Motives for Engaging with and Developing a Blockchain IS

Table 27 presents the motives that emerged from the first-step bottom-up coding process. The first column lists the motives (i.e., the codes), the second column provides an explanation of each code, and the third column gives an interview excerpt from our cases for each code.

Motives (Codes)	**Explanation** Businesses engage with and develop a blockchain IS to…	**Code examples from the cases**
Experimentation	experiment at the edge.	*"some IT group people have very good knowledge about blockchain, (…) but also, they wanted to experiment; that's also why we called it pilot project (…)."* (C03_I01)
Opportunity Seeking	search for new business opportunities.	*"(…) it is really about experimenting with the technology and then seeing an opportunity to (…) turn it into potential business."* (C07_I01)
Domain-specific Problems and Needs	address specific problems and needs of the application domain.	*"(…) there was a cyber—it was the war with [Country X] and there once was a cyberattack. All the computers and programs were shut down. That is one of the arguments. Also, that we need very safe data, and very safe data should be stored on the blockchain itself."* (C03_I01)
Decentralization	enable power decentralization.	*"So, technically you could do it with another technology, but the idea of this construct of being decentralized provides the attractiveness (…) that every company controls and owns their own data, and they decide who they share it with, and there is no central organization anymore that holds all the data."* (C04_I01)
Uniqueness	create uniqueness and authenticity of entries.	*"(…) that extract has its own unique hash code, identical to a hash stored in the Bitcoin Blockchain, so the C03's website*

		confirms the authenticity of this titles." (C03_I01)
Control	enable individual control over one's own resources.	*"you can share your data and you have control over your data. So, you know who you share the data with and you still can revoke the access that you have given to somebody."*(C01_I01)
Collaboration	enable cross-organizational collaboration.	*"(…) it makes a kind of cooperation between companies possible that was not possible before, because nobody was willing to share data to that extent (…), and we now hope that we will have the opportunity to do so technically."* (C05_I01)
Commons	create something common (e.g., a common vision, system, or resource pool)	*"Everyone's working towards that common good and common purpose (…)."* (C04_I02)
Trust	establish trust in a shared system.	*"You can do that (with a normal database) if people trust each other and if you trust the operator, you can do that. (…) However, I don't do that and most people do not have that trust either (…). Contrary, if you share a bigger system, in which you can write in a consensus and in which you can only make changes together in the consensus, then it creates more security about what is written in it."* (C09_I03)
Tokenized Assets	introduce authenticity and uniqueness in digital goods.	*"The main idea to introduce the blockchain was that a person can prove that, they are the unique owner of this property with these details."* (C03_I01).
Tokenized Services	create uniqueness and control over the digital expression of will.	*"(…) another key aspect are trust services, which are actually the digital expression of will, in other words, everything that is simply said the e-notary."* (C02_I02)
Innovation	create novel innovative products.	*"so for sellers, C19 also offers the possibility of invoicing or discounting or financing these BPU-based contracts, which is an important innovation (…)."* (C19_I21)
Efficiency	increase efficiency in inner- and intra-organizational processes.	*"Yes, what really makes our project special is that we ensure that this trade (…) enables us to manage (…) the existing local distribution network efficiently – more efficiently than before."* (C06_I03)

Customization	customize products and services to users' needs.	*"(...) you can create an incredible number of new customized products in trade finance if you use the technologies correctly (...)."* (C10_I03)
Domain-Specific Solutions	provide specific solutions to the problems and needs of the application domain.	*"(...) a few people in our network sent us articles about blockchain and said, "You should look at blockchain as a potential technology to solve some of the requirements of this regulation."* (C04_I01)
Capability Development	build up technical capabilities and expertise.	*"(...) building up (blockchain) technology knowledge. So, essentially, being able to say, "What can you do with it and what can't you do?"* (C05_I01)
Financing	get easy access to financial means.	*"(...) you just have a budget for promising projects or promising technologies, (...) and blockchain is one of them."* (C02_I03)
Marketing	market innovativeness of the company.	*"(...) we placed it in the press because we found it interesting that the market reacted to it in this way, which brought us a lot of publicity for very little money (...)."* (C09_I02)
Partnering	establish new and maintain existing partnerships.	*"I think what makes the big difference is that through this blockchain topic we dare to ally with partners who are not from our home turf."* (C05_I01)

Table 27. Summary of motives for engaging with and developing a blockchain IS

7.4.2 Systematization and Contextualization of Blockchain IS Motives

Figure 7 below presents the results from our second grounded analysis step, namely the mapping and grouping of the emerged motives to higher-level theoretical themes. In the paragraphs below, we describe the rationale for the positioning and grouping of the motives to the themes in the IS artifact reference framework along with contextual interview excerpts that showcase our rationale.

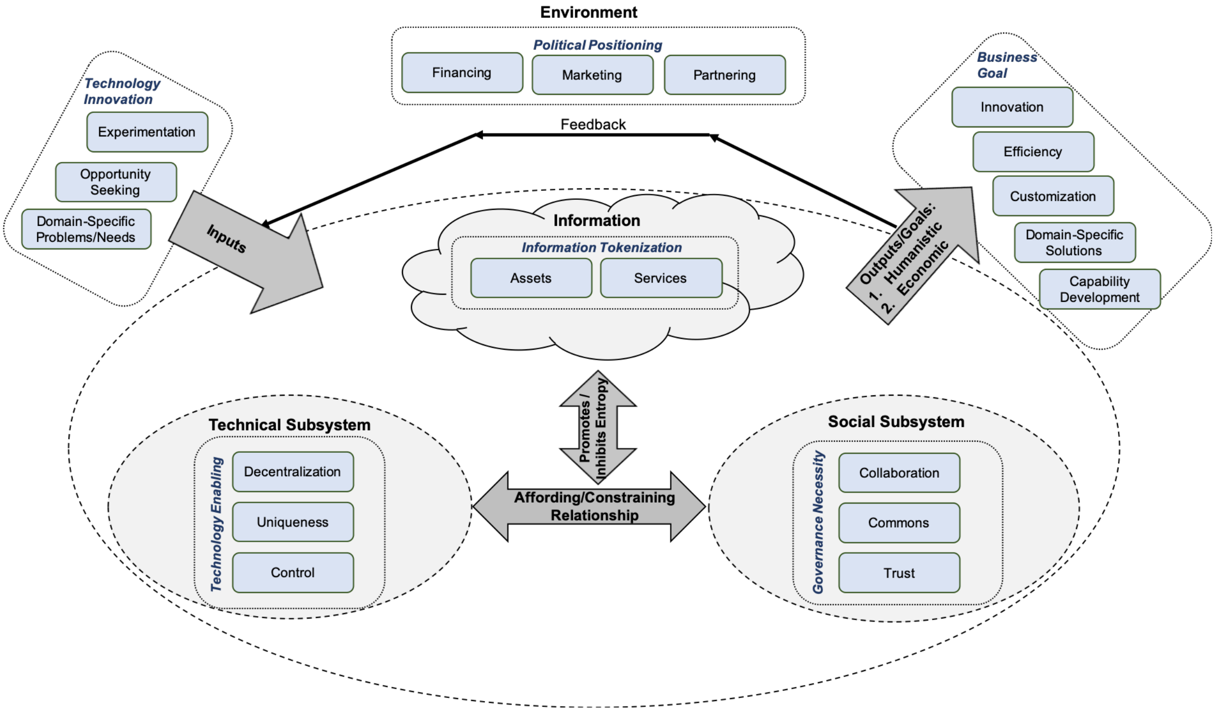

Figure 7. Motives for engaging with and developing a blockchain IS in practice along with the IS artifact reference framework of Chatterjee et al. (2020)

7.4.2.1 Input: Technology Innovation Motives

Experimentation, *opportunity seeking*, and *domain-specific problems* were positioned to the **Input** arrow and grouped as **Technology Innovation Motives**. The contextual analysis showed that when talking about these motives the interviewees specifically mentioned words like "initial driver", or "starting point" that ignited their engagement with the technology. Besides that, regardless of how general (experimentation) or specific (aim to address long-existing specific business problems) the motives were, the analysis in context showed that the common theme among these motives was to innovate with *"this novel technology"*. For example, interviewee C04_I03 mentioned that their motive was rather generally to experiment with blockchain and prove it wrong: *"initially, the driver to use the technology wasn't because we were bought in blockchain, (…) rather we wanted to be on the front lines of the skepticism, and basically prove why it wouldn't work."* (C04_I03) *(experimentation).* Another interviewee mentioned domain-specific contextual challenges, like political instability in the case of C03, that could be addressed by the promises associated with blockchain technology: *"(…) the government view was to ensure international-level security, that the data is not stored in one particular place, like in local domestic level servers or even the back-up servers (…)."* (C03_I01) (*domain-specific problems).*

7.4.2.2 Technical and Social Subsystem: Technology Enabling and Governance Necessity Motives

We assigned *decentralization, uniqueness,* and *control* to the **Technical Subsystem**. Each of the three motives described blockchain technology's features that *enable* businesses to do something. Thus, we also grouped them accordingly as **Technology Enabling Motives**. We assigned *collaboration*, *commons*, and *trust* to the **Social Subsystem**, since they describe the structures and relationships among the actors in the consortium. As they specifically center around governance-related aspects of the actors involved in such projects that necessitated the use of blockchain technology, we more specifically grouped these as **Governance Necessity Motives**. While we purposefully separated the individual motives during the initial bottom-up coding, from the contextual analysis, the strong affording/constraining relationship of the social and technical subsystems became very much evident. For example, to the question, "*how does blockchain technology help you to achieve your goals?*", interviewee C07_I01 answered by explaining first the technical feature of *decentralization* and *control* which allows different businesses to *collaborate* and develop *commons*: *"The solution so far (...) is to build a centralized database and bring all the data there. But that is primarily a problem because people want to have autonomy over their own data. (...) what you need is something that can guarantee decentralized data, yet still allows for data exchange between parties. If you put these two together, you (...) end up with the reason why we chose to use blockchain."* Another example is provided by C05_I01 who rather started from the social end and mentioned that blockchain enables (new) long-term collaborative relationships between businesses (even between competitors), which was not possible before. While emphasizing the need for *collaboration* here, C05_I01 went on and elaborated on the opportunity to do so technically, in that blockchain allows the opportunity to *decentralize* the authority and views on the data: *"I believe that it makes a kind of cooperation between companies possible that was not possible before, because nobody was willing to share data to the extent, or they were not legally permitted to share data to the extent, and we now hope that we will have the opportunity to do so technically."*

7.4.2.3 Information: Information Tokenization Motives

The motives of **Information Tokenization** *(i.e. assets* and/or *services)* were positioned in the information element as they centered around the value, role, and use of **information**. While information can take many different forms (e.g., digital asset certificates, digital will representation), abstracting from the specific instantiation, it became evident that the defining novel property of information, that emerged from the interaction of the socio-technical subsystems, was tokenization of information goods. Hence, these motives were grouped as **Information Tokenization Motives**. For example, interviewee C02_I01 purposefully put the specific instantiation of the data good in the background and explained: *"So the problem we wanted to solve is to enable us to digitally transfer ownership, whether it's a share or a property, a bond, or a property value of an old car, it doesn't really matter. It's simply a matter of transferring the value right digitally."* Besides that, C07_I01 explained why they decided to use blockchain technology rather than another inter-organizational system, such as EDI, along with the emergent tokenization property as follows: *"We think that what blockchain offers is more than just data interchange. (...) there's already a solution for simple data interchange that's called EDI and that works fine, at least from a technical perspective. (...) blockchain adds to this in that you can now also capture not only data but also behavior related to assets. An asset can be a bill of lading and we can now also trace and ensure correct transfer behavior."* Thus, the interviewee clearly emphasized that blockchain not only allows the opportunity to interchange data simply between businesses but also ensures proof of provenance of the transfer.

7.4.2.4 Output: Business Goal Motives

Innovation, *efficiency*, *customization*, *domain-specific solutions,* and *capability development* were grouped as **Business Goal Motives** and positioned to the **Output** arrow, as they described the desired outcomes and goals that motivate the interviewees to engage with and develop a blockchain IS. Similar to the input motives, the desired outcomes varied widely in the level of specificity. Some talked about general possibilities to increase intra- and inter-organizational processes, "*(...) so, today (our processes) are mainly paper-driven and not automated. There's lots of inefficiency, lots of delays, and also a bit of a peer-to-peer process in nature with many parties involved, with the retail banks and brokers. (...). It was also a distributed process in nature. Blockchain seems to be a good technology to be applied to these cases."* (C02_I03). Others more specifically explained their desire to customize services: *"Ultimately, (...) the system is designed in order to make government services more accessible and easier to use and/or trusted and (...) to improve services specifically."* (C03_I03). Again, others emphasized their goal to build up technical expertise about the technology, which they will be able to provide as a service to other future customers: *"The biggest goal for us was in the first step (...) building up (blockchain) technology knowledge. So, essentially, being able to say, 'What can you do with it and what can't you do?'"*

(C05_I02). Regardless of the specific instantiation, the common theme among the motives were business goals.

7.4.2.5 Environment: Political Positioning Motives

Finally, the interviewees occasionally mentioned motives to engage with blockchain to facilitate *access to financial means*, *market a company's innovativeness or the project itself*, and *establishing new and maintaining existing partnerships*. As they were mentioned as rather supporting motives that addressed the larger environment of the system and were used for political positioning reasons, we positioned them to the **Environment** of the IS reference artifact reference framework and grouped them as **Political Positioning Motives**. For example, in the case of C06_I03, combining the topic of renewable energies with blockchain as an enabler for digitalization facilitated easier access to public funding. Another example was provided by interviewee C09_I03, who stated that blockchain enabled them to initiate new partnerships: *"The whole thing was so hung up on the blockchain hype anyway, (…) it is a welcome hook to lift people out of their chairs (…)."* (C09_I03).

7.4.2.6 Business Case-driven motives for blockchain prototyping

Business-case-driven motives encompass the following rationales: tokenization of economic value, digitalization of services, and efficiency in intra- and inter-organizational processes. For example, the ability to tokenize economic value was of great importance for consortium C09. C09_I01 put it simply, *"We need it (blockchain) to tokenize trade assets."*. He elaborated on the tokenization rationale as follows, "*I need to be able to have a bill of lading generated digitally (…) this very same bill of lading must be transferable to CompanyX*[61] *afterwards. (…) And this very same bill of lading must perhaps be transferable again (…) That's where tokenization comes in."* (C09_I01). Being able to tokenize an asset was also of great relevance in consortium C03, *"The main idea to introduce the blockchain was that one can prove that, I am the unique owner of this property with these details."* (C03_I01). As such, entries in a blockchain cannot be changed, copied or altered in any other way. More technically speaking he emphasized, "*this is because the hash code is unique, it's only assumed to your property. So, extract information means that the extract contains the official information of ownership."* (C03_I01).

[61] For confidentially reasons the actual name of the company was removed.

Furthermore, the ability to provide trusted digital services was mentioned as yet another use-case driven rationale, as C02_I01 put it, *"so the problem we wanted to solve is to enable to digitally transfer ownership, whether it's a share or a property, a bond or a property value of an old car, a vintage car, whatever, it doesn't really matter, it's simply a matter of transferring the value right digitally."* While this seems to overlap with the earlier mentioned tokenization of assets interviewee C02_I02, delimited it as follows: *"One is to represent an asset digital, which is of course is strongly connected to the blockchain, the second are trust services, which are actually the digital expression of will, in other words everything that is simply said the e-notary."*. Besides that, C07_I01 delimited blockchain adoption from other interorganizational systems, such as EDI, as follows, *"We think that what blockchain offers is more than just data interchange. (...) there's already a solution for simple data interchange that's called EDI and that works fine, at least from a technical perspective. (...) blockchain adds to this in that you can now also capture not only data but also behavior related to assets. An asset can be a bill of lading and we can now also trace and ensure correct transfer behavior"*.

Finally, increasing intra- and inter-organizational processes was mentioned as an underlying rationale for blockchain adoption. "*(...) so today (our processes) are mainly paper-driven and not automated, lots of inefficiency, lots of delays, and also a bit of a peer-to-peer process in nature with many parties involved, with the retail banks and broker. (...). It was also distributed process in nature. Blockchain seemed to be a good technology to be applied to that use case."* (C02_I03). While use-case driven motives represent essential rationales for consortia to adopt blockchain technology and kick-start prototyping, as explained by C06_I01 quite often they were not the initial rationales, *"You have to consider, it was created in the beginning of the big blockchain-hype and on the one hand of course blockchain was just a bit set in some places (...) on the other hand it is really a technique that fits to many problems that we have, like process problems (...)."*

7.4.2.7 Governance-driven motives of blockchain adoption

Finally, from the interviews we elicited governance-related motives for blockchain adoption that can be broken down into the rationales, need for: collaboration, decentralization, control, and trust. As for collaboration, C05_I01 mentioned, "*I believe that it makes a kind of cooperation between companies possible, that was not possible before, because nobody was willing to share data to the extent / or it is not legally permitted to share data to the extent, and we now hope that we will have the opportunity to do so technically*". While, emphasizing the need for collaboration here, C05_I01went on and elaborated on the opportunity to do so technically, in that blockchain allows to decentralize the control and views on the data. Similarly, C07_I01 described their joint need for collaboration and decentralization even more precisely, *"The solution so far (…) is to build a centralized database and bring all the data there. But that is primarily a problem because people want to have autonomy over their own data. (…) what you need is something that can guarantee decentralized data, yet still allows for data exchange between parties. If you put these two together, you (…) end up with the reason why we chose to use blockchain."*

Beyond collaboration, the need for control also emphasized the decentralization rationale. For example, C04_I01 stated, *"I would say companies don't have an appetite that a database exists that holds every transaction in the pharmaceutical industry. It could be hacked and the company who runs it could have too much control. So, technically you could do it with another technology, but the idea of this construct of being decentralized provides the attractiveness (…) that every company controls and owns their own data and they decide who they share it with and there is no central organization anymore that holds all the data."*. More simply put, C01_I01 described the need for decentralized control as follows, *"you can share your data and you have control over your data. So, you know who you share the data with and you still can revoke the access that you have given to somebody"*.

Finally, besides the rationale for collaboration decentralization and control, the need for a trusted system was mentioned as a driving rationale for blockchain adoption. For example, when asked provocatively, why a blockchain was chosen, C09_I03 emphasized, *"You can do that (with a normal database) if people trust each other and if you trust the operator, you can do that. (…) However, I don't do that and most people do not have that trust either (…). Contrary, if you share a bigger system, in which you can write in a consensus and in which you can only make changes together in the consensus, then it creates more security about what is written in it."* Similarly, C06_I02 pointed out that they decided to use blockchain technology in order to create a truly peer-to-peer electricity market, where interpersonal or interorganizational trust is no longer required.

7.4.3 A Time and Relevance Perspective on Blockchain IS Motives

The initial bottom-up coding as well as the mapping of the motives to the IS artifact reference framework already indicated that businesses showed multiple motives for engaging with and developing blockchain ISs that evolved over time. To gain a more in-depth understanding of this development of the motives over time and their relevance, we again revisited our data. We analyzed contextually meta-information such as time and commitment.

By analyzing the motives in a broader context and focusing on contextual meta-information, two phases emerged in which the different groups of motives were expressed to different extents. In **Phase 1**, which we identified as the initial exploration phase, the motives highlighted in light blue in Figure 8 emerged as the key driving motives of businesses to engage with blockchain. In **Phase 2**, which we identified as the prototyping phase, motives highlighted in dark blue in Figure 8 were predominant for businesses to develop blockchain ISs. In the following, we describe these observations in more detail along with examples from our interviews.

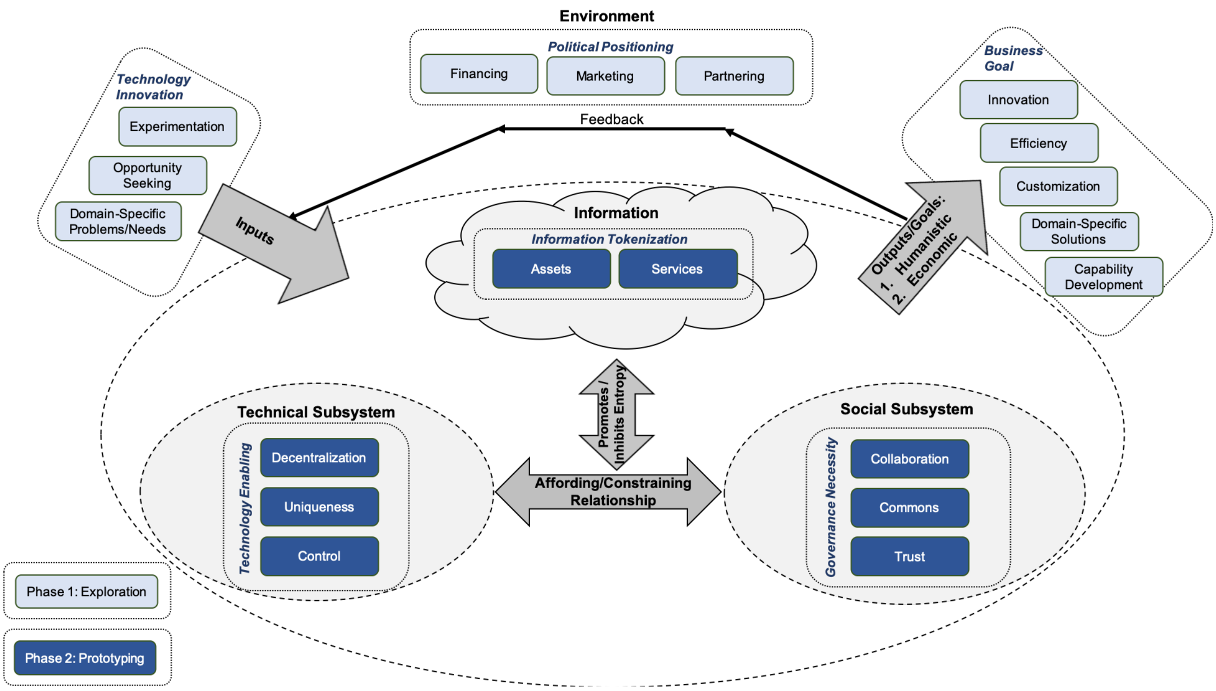

Figure 8. Development of motives for engaging with and developing a blockchain IS over time

In most cases, the interviews proceeded similarly, with the interviewee starting from the beginning of the project and explaining its development. Paying special attention to the time-dimension, *Technology Innovation*, *Political Positioning* and *Business Goal* motives have crystallized as the predominant group of motives businesses have for engaging with blockchain during the first phase. This “first phase” represented itself in that the interviewees often used words like “initially” and “at the beginning of the project”, or referred to specific starting points. When talking about *Technology Innovation*, *Political Positioning*, and *Business Goal* motives, such time limitations or throwbacks were often made. For example, interviewee C19_I01 explained their initial *Business Goal* motive as follows: *“So the legend* *goes that, it started off from a conversation between Person X, (…) and a potato farmer down in Country X, and they were really trying to look at ways to improve their trading business."* (C19_I01). Besides that, when mentioning these motives, the interviewees' tone emphasized rather loose commitment to blockchain technology itself. This was shown by the fact that the interviewees, when talking about the motives in this early phase, often used words like, "engagement with", or "get to know" rather than referring to investment intense development. For example, interviewee C19_I01 went on to explain their *Technology Innovation* motives along with their *business goal* motives as follows: *"We're probably talking about, maybe, beginning of 2016. So Person X gave mandate to his team to start looking at exploring options from a technology perspective of, 'How can you digitize and simplify the trade finance process?' So obviously, looking at the various options, they identified blockchain and distributed technology as a promising field to do so."* (C19_I01).

As the interviews went on and the narratives referred to the current state, the interviewees rather emphasized *Technology Enabling*, *Governance Necessity* and *Information Tokenization* motives. While sometimes this change in motive was rather subliminal, meaning that a clear cut between phases was rather difficult to make (in particular also given the fact that the different consortia were in different phases when we interviewed them), other times the change in motive, or better said, the reevaluation of the technology, was even specifically mentioned. The following interview excerpt from C19_I02 exemplifies this: *"With the expansion of the project group to include several banks, we definitely questioned and discussed the necessity of blockchain technology. But we actually agreed that distributed ledger technology (…) actually offers exactly what such a consortia structure needs, namely the possibility of defining rules via the code that ensure that you don't run into the problems that you would with a central database (…)."* (C19_I02). C19_I02 emphasized the technology necessity motives of *decentralization* and *control* from a system governance perspective (*collaboration*) as the key motives to use blockchain after they got more involved in the project and even reevaluated the necessity of the technology. Besides that, once projects were initiated, the motives of businesses to develop blockchain ISs became more substantial. This manifested itself in the fact that the interviewees no longer talked only about engagement but much more about Blockchain IS development and the necessity of the technology for their purposes. For example, a colleague of C19_02 from the same consortium went further and emphasized the emergent property of *tokenization* of the interaction of the subsystems as the purpose of blockchain-based development: *"(…) the reason why we build on blockchain technology at the moment* (2019, when the interview was conducted) *is one key point (…) there exists only one copy of that transaction on the blockchain."* (C19_I01).

All in all, the contextual meta-analysis revealed that the motives of businesses to engage with and develop blockchain ISs developed over time. Besides that, the tone that the interviewees used indicated that the second-phase motives showcase greater relevance for engaging with and developing blockchain information systems than those from the first phase.

7.5 Discussion

Interested in blockchain as a new phenomenon that has mobilized and continues to mobilize a substantial amount of resources, we elicited practitioners' motives for engaging with and developing blockchain information systems. The 19 motives presented in Table 27 provide a thorough overview of the motives of members of business consortia for using blockchain technology. Contextualizing the motives and relating them to higher-level theoretical themes, along with the reference framework of Chatterjee et al. (2020), allows us in the following to theorize on unique blockchain motives and characteristics. Subsequently, we will differentiate blockchain IOSs from other IOSs and derive recommendations for academics and businesses engaged in blockchain decision-making on how to evaluate and justify blockchain engagement.

7.5.1 What is unique about Blockchain?

Motives for using blockchain are broadly diversified and they develop over time, as our analysis has shown. Looking at this change over time and the relevance of the motives guided by the IS artifact reference framework now allows us to explain which motives apply to technological disruption in general, which motives are actually blockchain specific, and what characterizes blockchain information systems.

Chatterjee et al. (2020) describe in their paper that an IS artifact consists of mutually adaptable subsystems that manage entropy and strive to balance it. The entropy of a system measures how organized/disorganized it is (G. A. Swanson et al., 1997). In a disorganized system (when entropy is high), the outcomes are random and uncertain. In contrast, when entropy is low (when the subsystems are in harmony), the systemic outcome can be achieved.

Our analysis of the development of the motives clearly shows that at the beginning there was little clarity about the interaction between the subsystems since the interviewees related their engagement with blockchain primarily to the input and output factors, as well as to the environment. However, the interplay between the social and technical subsystems was rather unclear in most cases. Also, interviewees spoke of *"engagement"* with blockchain rather than the development of blockchain ISs, and thus foregrounded the creative process that comes with technological disruption. According to Chatterjee et al. (2020), this is common for phases of technological uncertainty. In this phase, companies invest in technology to eliminate uncertainty and to stabilize the system. Therefore, we characterize the motives classified within input, output, and environment as less blockchain-specific but, *general engagement motives under high technological uncertainty*.

Over time, however, the motives of businesses for engaging with blockchain have changed, as our analysis showed. Some companies even spoke of a reevaluation of the technology. The motives that the companies mentioned after the reevaluation phase clearly reflect the harmony of the socio-technical subsystem. The examples given in Section 7.4.2.2 (Technical and Social Subsystem) illustrate the affording/constraining relationship very well. While some interviewees tended to emphasize the technical motives which, for example, enabled new types of social relationships, other interviewees emphasized the social aspects such as the lack of trust that necessitate such a technical solution. This unification of the motives that describe the social and technical relationship highlights the low level of system entropy and characterizes the *unique blockchain motives*. These motives essentially describe what kind of interaction blockchain technology enables, or, the other way around, what kind of social demands necessitate the technology.

As the social and technical subsystems become harmonized, the systemic character of the socio-technical interaction emerges and shapes information (Chatterjee et al., 2020; Henfridsson & Bygstad, 2013). This manifested, in the case of blockchain, in the *tokenization* of information. The interviewees, as shown in Section 7.4.2.3 (Information Tokenization) drew on the specific socio-technical interaction and described the unique property that emerges from this interaction, sometimes as their motive to engage with blockchain technology. Thus, *tokenization* can be *characterized as the systemic character* that gives meaning and utility to the socio-technical interaction and hence describes the unique property of blockchain ISs.

In the following, we discuss in detail how these findings contribute to the IOS discourse by highlighting differences between *motives to engage with blockchain* and *motives to adopt and use an IOS*.

7.5.2 Why engage with Blockchain as an IOS?

Blockchain systems can be regarded as a class of IOS (Seebacher & Schüritz, 2019) as they facilitate electronic exchanges and interactions between two or more participating organizations (Robey et al., 2008). In the following, we discuss how blockchain IOSs differ from IOSs in general in terms of the development process, environmental influences, the nature of innovation, as well as motives attributed to the technical, social, and information subsystem.

First, in line with other research on blockchain IOSs (Miscione, Goerke, et al., 2019), this research observed that the process of designing and building blockchain IOSs seems to be distinct from how previous IOSs were built. Interestingly, while "adoption" is an important theme in the IOS literature (e.g., Robey et al., 2008), we did not find many articles explicitly talking about the process of building IOSs. Rather, the large body of literature on adoption seems to suggest a high relevance of the decision regarding whether or not a (ready-made) system should be adopted. Moreover, studies on influences, like coercive pressures (Hart & Saunders, 1997), suggest a key position of certain companies as drivers of such adoption processes. Based on that, we conclude that those focal firms also played a key role in implementing IOSs. In terms of blockchain-based IOSs, however, the idea of decentralization appears to be anchored from the very beginning. While in some of the analyzed cases blockchain-based IOSs were built within the context of existing trading relationships, many initiatives (Zavolokina et al., 2020b) also emerged independently of such preexisting collaborative networks with their inherent power structures (Seebacher & Schüritz, 2019). Hence, we observe how blockchain technology opened up opportunities for establishing relationships with new partners.

Second, we recognize that environmental influences triggering engagement with blockchain IOSs differ from motives to adopt and use IOSs. While we have evidence for motives like necessity and stability (Chi & Holsapple, 2005) in our findings, environmental influences like power structures (e.g., business partner power) and culture/institutional forces (e.g., mimetic/coercive/normative pressures, institutional trust) (Robey et al., 2008) are only implicitly expressed in the studied consortia. In this regard, motives associated with political positioning reveal companies' fear of missing out on blockchain as an important technology trend, which in turn also suggests the existence of underlying competitive and mimetic pressures. Hence, the hype around blockchain technology and the general discourse around it was a main trigger for companies to engage with the technology, whereas existing power structures and culture/institutional forces could only be indirectly observed in our dataset.

Third, innovation in the context of blockchain IOSs seems to differ from how IOS literature treats innovation. IOS literature refers to innovation from an outcome perspective, as in organizations adopting IOSs to becoming more innovative because of employing an IOS (Chi

& Holsapple, 2005). IOS literature also refers to characteristics of an IOS innovation itself in terms of impacting adoption and diffusion of IOSs in organizations (Robey et al., 2008). In comparison, experimentation, opportunity seeking, and collaborative learning are frequently mentioned motives to engage with blockchain in the studied consortia. In this view, blockchain consortia emerge as a "locus of innovation" (Powell et al., 1996) to which different companies contribute resources and expertise with the objective to strengthen existing or develop new competencies.

Fourth, focusing on the subsystems, we find unique motives related to blockchain-based IOSs in comparison to IOSs in general. As for the technical subsystem, the identified motives of *uniqueness* and *control* can be associated with the *necessity* and *legitimacy* motives of IOS adoption (Chi & Holsapple, 2005) as legal requirements or external norms may force companies to retain autonomy over their data while collaborating with others, for instance. In blockchain-based IOSs, however, those motives do not seem to primarily relate to external influences. Indeed, companies strive for uniqueness, control, and decentralization of power (over the data) in their own interest and as a necessary precondition to achieve the *Governance Necessity* Motives (*collaboration*, *commons*, *trust*) within the social subsystem. IOS literature refers to both the *asymmetry* motive, as in exerting power and control over other organizations, and the *reciprocity* motive (i.e., using an IOS facilitates trust and collaboration) as adoption motives (Chi & Holsapple, 2005). The emphasis on decentralization and the identified governance necessity motives in the studied cases suggest that companies make a conscious effort to share and distribute power for mutual benefit and try to counteract asymmetry, rather than trying to reinforce dominant positions in a collaborative network.

Besides unique blockchain motives related to the *Technical* and *Social* Subsystem, *Information Tokenization* sets blockchain IOSs apart from previous types of IOS. Clearly, the use of blockchain to provide tokenized assets and services specifically relates to the uniqueness of blockchain information systems, which, on the one hand, address weaknesses and gaps of existing forms of IOS, and on the other hand, facilitate a novel understanding of the value of information (O'Dair, 2019).

All in all, as already indicated in Section 7.2.3., the motives of businesses to engage with blockchain are not directly comparable to prior research in IOS adoption motives (as these deal with the adoption of a ready-made system). However, this comparison allows us to reconfirm that the interplay of motives from the social and the technical subsystem (e.g., decentralization of power) are exactly those motives that *motivate members of business* *consortia to use blockchain technology* as IOSs and not use existing IOSs. Moreover, the above comparison of the identified motives and IOS adoption motive shows that *information tokenization* characterizes the uniqueness of blockchain information systems.

Finally, we discuss what these insights mean for blockchain decision-making concerning the evaluation and justification of blockchain engagement.

7.5.3 What can Blockchain Decision-Makers learn?

Decision trees provided by prior research to support blockchain decision-making have so far largely focused only on the technical aspects of the technology. We add to this stream of literature three aspects that could supplement as well as sharpen blockchain decision-making.

Motives for using blockchain technology are highly diversified and develop over time in practice. This is not surprising given the high technology uncertainty that businesses face with the emergence of novel technological disruption that is claimed to revolutionize businesses or even entire industries (Beck et al., 2017). Thus, motives for engaging with blockchain are driven in earlier phases by the desire of organizations to reduce their uncertainty about the technology (*Technology Innovation*, *Business Goal*, and *Political Positioning* motives). These *early engagement motives* have largely been neglected by prior blockchain research so far. However, they could be valuable additions to existing decision trees (Betzwieser et al., 2019; Pedersen et al., 2019) to help differentiate the phase that blockchain consortia are in. Businesses involved in blockchain consortia can benefit from these insights as doing so would enable them to better understand their situations and manage expectations towards their companies. Further, managers who are not yet part of a consortium but interested in joining blockchain consortia can use these insights to evaluate the motives of businesses involved in blockchain consortia and, consequently, their development state.

Over time, however, understanding of the technological capabilities and the social needs grows and harmonization of the socio-technical interaction arises. Thus, motives to build an information system that are specific to the chosen technology (blockchain) and the social context (business blockchain consortium) manifest themselves (*Technology Enabling and Governance Necessity* motives). Concerning prior works, on the one hand, the *Technology Enabling* motives (*decentralization*, *uniqueness*, and *control*) are in line with findings in prior works presented in section 7.2.3. Within the decision trees, *decentralization* and *control* were integral parts, as they differentiate between the number of involved parties or the allocation of read/write rights to a ledger (Meunier, 2018). The *uniqueness* motive, on the other hand, relates to questions of the necessity of a single source of truth of data and immutability of data, which was also covered within existing decision trees (e.g., Betzwieser et al., 2019). The *Governance Necessity* motives of *trust*, *commons*, and *collaboration* have so far not, or not adequately, been addressed in current decision frameworks. However, they do address important research streams on blockchain governance. For example, the ability to create *Trust* among multiple parties is covered in a variety of cross-organizational documents handling applications (Beck et al., 2016; Thakur et al., 2020). As for the *commons* motive, blockchains by default create common goods, such as the ledger or necessary resources to develop or maintain the system (Cila et al., 2020). Creating commons is not an end in itself, but it may lead to benefits for involved parties aside from the question of whether an actual blockchain system is developed (Hardin, 1968; Ostrom, 1990). Lastly, the motive of *collaboration* is emphasized strongly in blockchain research, as blockchains are said to allow for new modalities of inter-organizational collaboration (Dozier & Saunders, 2020; Kostić & Sedej, 2020; Seebacher & Schüritz, 2019). Although these socially-driven motives have been given little consideration in research on blockchain decision trees to date, they are important motives of practitioners and well debated in current research streams on blockchain governance. Thus, for academics, we recommend placing an equal emphasis on these motives stemming from the social subsystem when designing decision trees. For businesses involved in or interested in blockchain consortia, we recommend not only considering technical feasibility but also socially driven aspects in their decision-making about the necessity of blockchain technology.

Finally, once the socio-technical subsystems work in tandem, the systemic character arises and describes the information system's unique property: *okenization*. While prior research acknowledges the use of blockchain to tokenize high-value assets in a variety of cases (Bauer, Zavolokina, & Schwabe, 2019; Franceschet et al., 2019; Liu, 2016; Notheisen et al., 2017), too little importance is given to the fact that blockchain is currently the only technology that makes tokenization possible under the above described social requirements. However, in practice, we observe that businesses engage with blockchain particularly to share and distribute power as well as to allow the opportunity to assign property rights to information goods by introducing digital scarcity (Miscione et al., 2018). Thus, for academics and practitioners, we recommend carefully considering the importance of tokenization for their application cases, but also the changing nature of tokenized information and its impact on businesses when confronted with technology choices.

7.6 Conclusion

In this paper, we revisit blockchain as a socio-technical phenomenon and study the motives of members of blockchain consortia for choosing the technology. Studying the motives of those who use the technology, we shed light on the often-asked question *"Why Blockchain?"* and thereby explicate the particular characteristics of this novel type of inter-organizational system. Such a cross-case analysis provides rich insights that are relevant for academics, businesses, and society. First, for academics, this study offers grounded empirical evidence that allows the opportunity to advance and specify motives for using blockchain technology. Besides advancing theories in this domain, the insights can help other researchers to further advance their development work on blockchain applications and platforms. Once there is a clear understanding of why the use of blockchain technology for certain applications and platforms is non-neglectable, blockchain research can focus efforts on the advancement of these instead of having to deal with the recurring question of "*Why blockchain?"*

Second, the insights are highly relevant for practitioners that are faced with difficult investment decisions regarding the usage of blockchain technology. By gaining insight into the motivations of other similar projects, decision-makers can make more informed decisions that quite often involve high stakes.

Finally, by enabling opportunities to push blockchain research and its applications further, society may benefit through their advances and use.

This study is not without limitations. However, these limitations open avenues for further research. We acknowledge that the projects under investigation are still at rather an early stage, and a lot of development effort is yet to come. While we specifically looked for projects that had moved beyond the mere prototyping phase, in many cases, it will still be some time before their systems will actually be launched. The consortia could encounter many more hurdles that might require them to again rethink the choice of technology, which could thus provide further insights that we have not yet uncovered. At the same time, motives that are particularly expressed in our dataset, such as political position motives and technology innovation motives, are clearly related to blockchain still being a nascent and hyped technology at the time when the consortia were initiated. As such, they may become less relevant over time. In addition, power structures, which have received much attention in IOS literature (Hart & Saunders, 1997), and imbalances in power may become more relevant as blockchain consortia move beyond the stage of collaboratively building an IOS. Hence, in the future, researchers could reevaluate the identified motives using a dataset that includes more mature blockchain projects. Besides that, we want to highlight that, while the study provides insights into many well-reasoned motives for businesses to apply blockchain technology, it is not the best solution for every case. For many innovative applications, blockchain is certainly not necessary. To identify whether blockchain, from a purely technical perspective, is the right solution in a specific case or not, businesses can use existing DM (Betzwieser et al., 2019).

All in all, with this comprehensive overview of the usage potential of blockchain technologies, we hope to enable more informed decision-making and inspire further investigations in the field.

8 PAPER VII: Managing Blockchain Consortia

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Abstract

The hype around blockchain-based systems continues, especially in the case of blockchain consortia. As these consortia mature and start to put first products on the market, it is time to reflect on their challenges along their way to help other consortia to thrive. This is where this study commences: in an effort to develop actionable insights by understanding and contextualizing the ongoings in and around blockchain consortia, we interviewed 53 key stakeholders of in total 19 consortia from various domains on choices around technology, their business model, governance, collaboration mode, and legal aspects. This study contributes 17 actionable recommendations based on the areas of governance, building together, membership, commons, legal, trust, hype, and competition. We believe these recommendations to not only help managers of blockchain consortia but also managers interested in participating in blockchain consortia to better understand this particular mode of collaboration and to derive actions accordingly.

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8.1 Introduction: Towards Blockchain Consortia

Blockchain technology, utilized both as platform or infrastructure[62], has attracted significant attention in both academia and practice in recent years. The high level of interest in blockchain technology in the business world is particularly evident in a growing number of blockchain consortia. In such a consortium (one form of interorganizational cooperation), different companies join forces to jointly develop and run blockchain-based systems in the form of platforms, infrastructures, or even both. These efforts are motivated, among others, by blockchain's promise of enhancing operational efficiency, leading to new products, or better data handling[63].

Despite these prospects, and despite of years of development, the maturity of blockchain-based systems outside of the domain of cryptocurrencies can be considered low. Several reasons are cited as causes for this low maturity[64], which can be roughly classified into two categories: challenges within and external to the consortium. For the former, several challenges around blockchain governance[65], decisions[66], and business models[67], among others, are well documented in practice and research. As for external challenges, previous research on interorganizational information systems shows that the motives to build such systems, besides individual, internal gains, often relate to challenges in the participating companies' external environment, e.g., to meet necessary regulatory demands or become

[62] See Rossi, E., and Sørensen, C. 2019. "Towards a Theory of Digital Network De/Centralization: Platform-Infrastructure Lessons Drawn from Blockchain," SSRN Scholarly Paper No. ID 3503609, SSRN Scholarly Paper, Rochester, NY: Social Science Research Network, December 13. (https://doi.org/10.2139/ssrn.3503609).

[63] See Bauer, I., Zavolokina, L., Leisibach, F., and Schwabe, G. 2020. "Value Creation From a Decentralized Car Ledger," Frontiers in Blockchain (2:30), Frontiers. (https://doi.org/10.3389/fbloc.2019.00030).

[64] See, for example, studies conducted by ESG intelligence (https://esg-intelligence.com/access-enterprise-blockchain-intelligence/list-of-all-blockchain-consortia/) or PwC (https://www.pwccn.com/en/research-and-insights/publications/global-blockchain-survey-2018/global-blockchain-survey-2018-report.pdf)

[65] See Miscione, G., Klein, S., Schwabe, G., Goerke, T. M., and Ziolkowski, R. 2019. "Hanseatic Governance: Understanding Blockchain as Organizational Technology," in ICIS 2019 Proceedings, Munich, Germany, 15 December 2019 - 18 December.

[66] See Ziolkowski, R., Miscione, G., and Schwabe, G. 2020. "Decision Problems in Blockchain Governance: Old Wine in New Bottles or Walking in Someone Else's Shoes?," Journal of Management Information Systems (37:2), Routledge, pp. 316–348. (https://doi.org/10.1080/07421222.2020.1759974).

[67] See Chong, A. Y. L. C., Lim, E. T. K., Hua, X., Zheng, S., and Tan, C.-W. 2019. "Business on Chain: A Comparative Case Study of Five Blockchain-Inspired Business Models," Journal of the Association for Information Systems, pp. 1308–1337. (https://doi.org/10.17705/1jais.00568).

more responsive to environmental changes[68]. Besides inducing companies to establish a consortium, external challenges also impact a consortium over the course of its lifecycle. This is in line with research on organizational contingencies, which focuses on how organizations are – beyond internal challenges – shaped by their environment[69]. In addition, dealing with internal and external challenges were found to influence not only the design, management, and operation of a blockchain consortium but also the blockchain system itself. Such challenges include the European general data protection regulation (GDPR), which creates difficult barriers for blockchain projects to overcome[70]; blockchain hype, which does not necessarily result in excitement but may in fact represent a source of skepticism[71]; or anti-trust laws, which influence a consortium's choice of partner firms[72].

Against this background, we argue that internal as well as external challenges have a crucial influence on blockchain consortia and may, if they are neglected by managers of consortia, lead to an early failure, delay, or stalemate of collaborative endeavors to build blockchain-based infrastructures or platforms. To make sure these systems survive and thrive, managers of blockchain consortia need to be aware of these, know of potential effects of such challenges and conflicts, and be equipped with approaches to deal with these to envision ways to capitalize on opportunities or remedy potential detriments these can cause.

This is where our study[73] commences. In this article, we develop practicable recommendations for managers of blockchain consortia. To this end, we believed talking to actual blockchain consortia and studying their challenges and resolutions to these was the most promising starting point. So, instead of relying mainly on academic work on what challenges interorganizational networks and systems perceive and how these were dealt

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[68] See Chi, L., and Holsapple, C. W. 2005. "Understanding Computer-mediated Interorganizational Collaboration: A Model and Framework," Journal of Knowledge Management (9:1), (E. Tsui, ed.), Emerald Group Publishing Limited, pp. 53–75. (https://doi.org/10.1108/13673270510582965).

[69] See Sambamurthy, V., and Zmud, R. W. 1999. "Arrangements for Information Technology Governance: A Theory of Multiple Contingencies," MIS Quarterly (23:2), pp. 261–290.

[70] See Finck, M. 2019. "Blockchain and the General Data Protection Regulation: Can Distributed Ledgers Be Squared with European Data Protection Law?," European Parliament. (https://data.europa.eu/doi/10.2861/535).

[71] See Koster, F., and Borgman, H. P. 2020. "New Kid On The Block! Understanding Blockchain Adoption in the Public Sector," in Hawaii International Conference on System Sciences, p. 10.

[72] See Zavolokina, L., Ziolkowski, R., Bauer, I., and Schwabe, G. 2020. "Management, Governance, and Value Creation in a Blockchain Consortium," MIS Quarterly Executive (19:1). (https://aisel.aisnet.org/misqe/vol19/iss1/3).

[73] Data underlying this study was collected within a larger research project on blockchain consortia. The data for this multiple-case study was gathered by members of the authors' research group and members of a global professional services firm in 2019. See appendix A for more details on the methodology of our conducted study.

with in the past, we were interested in empirical, observable challenges and ways how these can be dealt with brought forward by our interviewees. Consequently, we studied and analyzed interview data retrieved from over 50 members of in total 19 blockchain consortia (2-3 stakeholders per consortium) from various industries and domains, such as supply chains, land registries, energy infrastructure, health, or automotive, yielding over 60 hours of audio material. In our analysis, we focused on the following study questions:

1. Which internal and external challenges do blockchain consortia face?[74]
2. How do blockchain consortia respond to these challenges?[75]

This study is structured as follows: in section 8.2, we lay the foundation for this study by introducing concepts of interorganizational systems, business consortia, and blockchain technology, as well as the prospects blockchain technology brings to these. Then, in section 8.3, we provide an overview on our studied consortia by showing their core characteristics, e.g., consortia goals, members, business domain, and reasons for using blockchain technology. Sections 8.4 and 8.5, then, zoom in on their internal respectively external challenges and show corresponding recommendations accordingly. We conclude this study with concluding remarks in section 8.6, as well as notes on our methodological approach.

[74] This has been motivated by the fact that several researchers (see above) studied either single external challenges and their impacts in-depth or observe few but targeted consortia. Which of these can in fact be empirically observed and, more importantly, how these are dealt with, falls short in these studies.

[75] To better grasp what is actually new with blockchain consortia, we discuss, which of these challenges are blockchain specific by relating to known frameworks. There are several frameworks for studying internal or external influences, where problems can originate, such as the PESTEL, Porter's five forces, or the TOE framework. However, on their own, none of these frameworks proved sufficient for the analysis of our cases: for instance, the PESTEL framework studies distant challenges, such as the political or legal environment, for which we found several impacts; PESTEL, however, neglects the immediate consortium environment, such as inter-firm rivalry or possible tensions between a consortium's members and their parent companies. Porter's five forces, for another, even though analyzing a firm's environment, rather focuses on a firm's competitiveness rather than forces which shape a firm. Consequently, we derived and iteratively adapted our own framework, which allowed us to account for all of our empirical findings. After we have identified and characterized these challenges, we strove to understand, how blockchain consortia dealt with these challenge's impacts. Consequently, we analyzed how companies dealt with these and how important each of these challenges has been deemed by them.

8.2 Inter-organizational Systems, Blockchain Technology, and Blockchain Consortia

Within this section, we first explain motives for building interorganizational systems. Then, we define blockchain technology in brief and introduce main prospects of blockchain technology for interorganizational systems.

8.2.1 Why Do Inter-Organizational Systems Exist?

Interorganizational systems (IOS) are defined as “automated information systems, shared by two or more organizations, and designed to link business processes”[76]. Different data exchange technologies, such as electronic data interchange (EDI), XML, web services and service-oriented architecture (SOA) are sample technologies underlying IOS, which, hence, enable the execution of interorganizational business processes and information sharing[77]. IOS have been gaining increasing attention in the information systems discipline since the 1980s. As such, information systems researchers have investigated specific technologies underlying IOS, fields of IOS application (e.g., supply chain management, electronic commerce), antecedents of IOS adoption, IOS adoption and diffusion processes, governance of IOS, and organizational consequences of IOS[76]. In their literature review of information systems research on IOS, Robey et al.[76] identify challenges such as aspects in the external environment, organizational readiness, perceived benefits, transaction characteristics, resource dependence, and institutional forces and challenges influencing IOS adoption were identified. Focusing specifically on motives of companies to enter interorganizational agreements and adopt IOS, Oliver[78] and Chi and Holsapple[68] distinguish between, for instance, the necessity motive (adopting an IOS to meet regulatory or legal requirements), the reciprocity motive (adopting an IOS to collaboratively work towards mutually beneficial goals), and the efficiency motive (adopting an IOS to increase efficiency within individual companies and the efficiency of interorganizational collaboration). In practice, it is often a combination of different motives that may influence companies to adopt an IOS.

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[76] See Robey, D., Im, G., & Wareham, J. D. (2008). Theoretical foundations of empirical research on interorganizational systems: Assessing past contributions and guiding future directions. *Journal of the Association for Information Systems*, *9*(9), p. 498. https://doi.org/10.17705/1jais.00171

[77] See Romero, D., & Vernadat, F. (2016). Enterprise information systems state of the art: Past, present and future trends. *Computers in Industry*, *79*, 3–13. https://doi.org/10.1016/j.compind.2016.03.001

[78] See Oliver, C. (1990). Determinants Of Interorganizational Relationships: Integration and Future Directions. *The Academy of Management Review*, *15*(2), 241–265.

8.2.2 Blockchain Technology and Blockchain Consortia

For the purpose of this study, we define a blockchain system to rely on the principles of decentralization, auditability, persistency, and pseudonymity[79]. Thereby, the use of blockchain systems is often linked to the reduction of transaction costs through the use of so-called "smart contracts"[80], disintermediation[81], certainty/trustlessness[82], and product innovations[83]. Relating to section 8.2.1, such blockchain-based systems can be understood as a class of IOS, i.e., systems facilitating data storage, data exchanges, or other interactions (smart contracts) between two or more participating organizations[84]. Such blockchain-based systems are applied in various industries and domains, for instance, land registries[85], supply chain management and logistics[86], and banking and finance[87].

In a blockchain consortium, different organizations join forces to develop, manage, govern, and operate a shared blockchain-based system. Within this research, we explicitly focus on organizations interested in applying blockchain technology to specific use cases,

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[79] See Thakur, V., Doja, M. N., Dwivedi, Y. K., Ahmad, T., and Khadanga, G. 2020. "Land Records on Blockchain for Implementation of Land Titling in India," International Journal of Information Management (52), pp. 101940–101940. (https://doi.org/10.1016/j.ijinfomgt.2019.04.013) and Zheng, Z., Xie, S., Dai, H., Chen, X., and Wang, H. 2017. "An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends," in Big Data (BigData Congress), 2017 IEEE International Congress On, IEEE, pp. 557–564.

[80] See Christidis, K., and Devetsikiotis, M. 2016. "Blockchains and Smart Contracts for the Internet of Things," IEEE Access (4), pp. 1–1. (https://doi.org/10.1109/ACCESS.2016.2566339).

[81] See Harwick, C. 2016. "Cryptocurrency and the Problem of Intermediation," The Independent Review (20:4), p. 569.

[82] See Beck, R., Czepluch Stemi, J., Lollike, N., and Malone, S. 2016. "Blockchain - The Gateway to Trust-Free Cryptographic Transactions," in Twenty-Fourth European Conference on Information Systems, Istanbul, Turkey, pp. 1–14.

[83] See Bauer, I., Zavolokina, L., Leisibach, F., and Schwabe, G. 2020. "Value Creation From a Decentralized Car Ledger," Frontiers in Blockchain (2:30), Frontiers. (https://doi.org/10.3389/fbloc.2019.00030) and Steininger, D. M. 2019. "Linking Information Systems and Entrepreneurship: A Review and Agenda for IT-Associated and Digital Entrepreneurship Research," Information Systems Journal (29:2), pp. 363–407. (https://doi.org/10.1111/isj.12206).

[84] See Chatterjee, R. 2017. "Anonymity and the Obfuscation Issues in the Cryptographic Currency: Bitcoin," International Journal Of Engineering And Computer Science (6:7) and Robey, D., Im, G., and Wareham, J. D. 2008. "Theoretical Foundations of Empirical Research on Interorganizational Systems: Assessing Past Contributions and Guiding Future Directions," Journal of the Association for Information Systems (9:9), pp. 497–518.

[85] See Benbunan-Fich, R., and Castellanos, A. 2018. "Digitization of Land Records: From Paper to Blockchain," in Proceedings of the 39th International Conference on Information Systems, San Francisco, CA, USA, December 13. (https://aisel.aisnet.org/icis2018/ebusiness/Presentations/15) and Miscione, G., Richter, C., and Ziolkowski, R. 2020. "Authenticating Deeds / Organizing Society: Considerations for Blockchain-Based Land Registries," in Responsible and Smart Land Management Interventions: An African Context, W. De Vries (ed.), CRC Press: Taylor & Francis.

[86] See Pournader, M., Shi, Y., Seuring, S., and Koh, S. C. L. 2020. "Blockchain Applications in Supply Chains, Transport and Logistics: A Systematic Review of the Literature," International Journal of Production Research (58:7), pp. 2063–2081. (https://doi.org/10.1080/00207543.2019.1650976).

[87] See Dozier, P., and Saunders, C. 2020. "The Inter-Organizational Perspective in Blockchain Adoption within an Ecosystem," in Proceedings of the 28th European Conference on Information Systems.

in contrast to blockchain technology consortia, which focus on advancing their respective blockchain technologies[88]. While little is known about steps involved in the development of IOS in general, previous research on the development of blockchain-based systems within consortia[89] suggests that blockchain consortia go through different stages, broadly *formation*, *negotiation*, and *operation*. Those stages can be related to stages of alliance formation and development[90] or the development stages of research and development consortia[91]. As such, initiators of blockchain consortia first have to set-up the consortium itself (e.g., identify and select partners), and negotiate and sign a cooperation agreement before they can start building a proof-of-concept of the blockchain-based system and establish governance structures in the operation phase. As exemplified by some prominent consortia (e.g., wetrade, Komgo) that have indeed launched a (productive) blockchain-based system, the step of "going live" requires the creation of a separate legal entity which replaces the original consortium. It needs to be noted that, along the stages of their development, blockchain consortia pursue relational integration, i.e., the development of interorganizational linkages, and information systems integration, i.e., the development of a joint IOS, at the same time[92]. Hence, in the process of building a system, consortium member firms continuously negotiate and renegotiate their very own future rules of collaboration. Figure 9 below illustrates a blockchain consortia's lifecycle.

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88 Such as R3 Corda (https://www.r3.com/corda-platform/) or IBM's Hyperledger Suite (https://www.ibm.com/blockchain/Hyperledger)

89 See L. Zavolokina, R. Ziolkowski, I. Bauer, and G. Schwabe, "Management, Governance, and Value Creation in a Blockchain Consortium." *MIS Quarterly Executive*, 19/1 (2020): 1-17. and G. Schwabe, "The Role of Public Agencies in Blockchain Consortia: Learning from the Cardossier." *Information Polity*, 24/4 (2019): 437–451

90 See Das and Teng (1997), op. cit.; H. Hoang and F. T. Rothaermel, "How to Manage Alliances Strategically Why do so many strategic alliances underperform-and what can companies do about it?," *MIT Sloan Management Review*, 58/1 (2016): 1-8.

91 See P. S. Ring, Yves L. Doz, and Paul M. Oik, "Managing Formation Processes in R&D Consortia." *California Management Review*, 47/4 (2005): 137–156

92 See W. Lee, P. Aggarwal, H. Shin, T. Cha, and S. Kim, "A Typology of Interorganizational Relationships: A Marriage, a Fling, or Something in Between." *International Journal of E-Business Research*, 2/2 (2006): 1–21

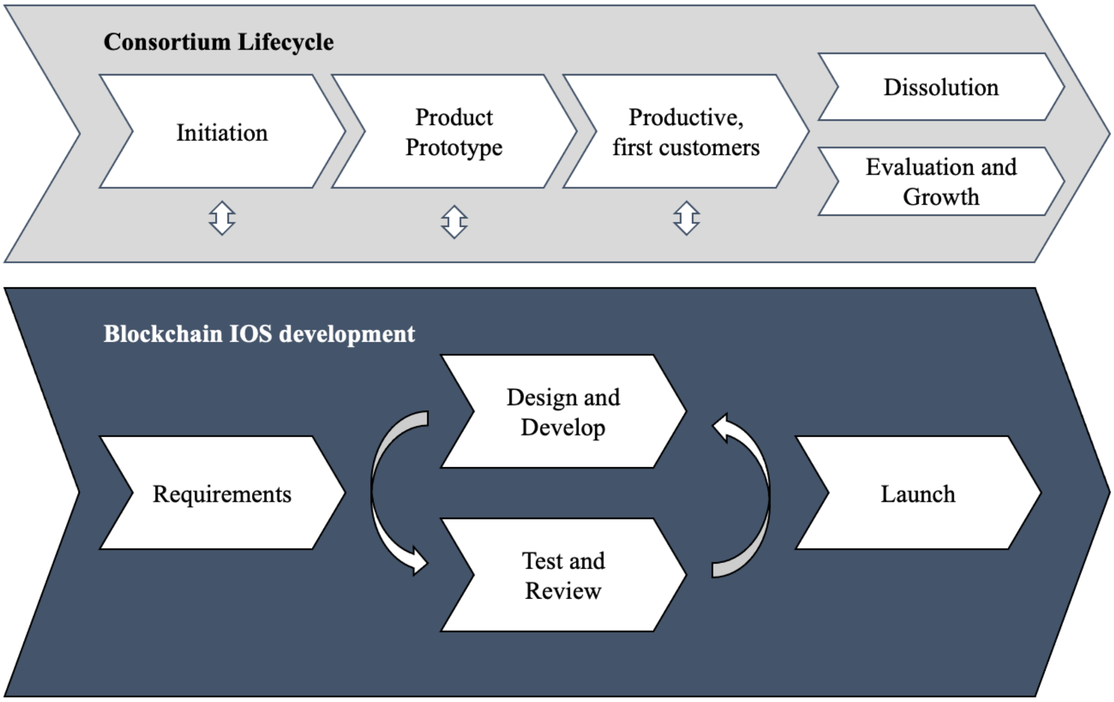

Figure 9. A Blockchain Consortia's Lifecycle

8.3 Zooming in: Overview and Characteristics of Studied Consortia

Within our study, we analyzed 19 blockchain consortia by conducting 53 interviews with several stakeholders from these consortia. With each interview lasting between one and one and a half hours, the total amount of analyzed interview material adds up to over 60 hours of audio material, providing us with a rich record to draw conclusions from. The studied consortia and their respective member firms are situated in different industries including but not limited to finance, logistics, healthcare and mobility (see table 29-31 for general characteristics). Thus, this variety of industries, in which our consortia operate, allowed us to draw common insights regardless the peculiarities of their industries. Most of our studied consortia – same as most of the blockchain applications outside of cryptocurrencies – are prototyping first potential solutions of blockchain-based systems. Consequently, our study focuses primarily on challenges within the early stages of a blockchain consortium's lifecycle as seen in figure 9 above. Consequently, perceived challenges upon growth or organizational maturity (exceeding the form of a blockchain consortium) are not part of this study. The respective lifecycle stage per consortium can be seen in the following table (divided along maturity into product prototype, productive solution, or dissolved), which also gives an overview of our sample of blockchain consortia, i.e., sector addressed by their intended blockchain-based system and the key idea underlying the system. Besides the specific motives associated with the intended system itself, four motives for forming/joining a consortium and building a blockchain-based system can be generally distinguished[93]: 1) *Technology innovation*: blockchain consortia provide member firms to explore and experiment with an innovative technology as well as to collaborate with other organizations, 2) *Political positioning*: blockchain is adopted to obtain access to innovation budgets and establish new or maintain existing partnerships, 3) *Business prototyping*: blockchain is adopted to realize new products and services and / or improve efficiency, and 4) *Governance necessity*: blockchain is adopted to enable decentralized access and control over information resources without having to rely on a third party. The following table presents the studied consortia along their industry, goal, and participants and their role in the consortium.

[93] See "Why Blockchain" in chapter seven

Consortium	Sector	Goal	Lifecycle Status (early 2020)	Funding	Founded	Interviewees	
C01	Mobility	Track and trace car related data.	Product Prototype	Public	2017	C01_I01: Academic partner C01_I02: Business partner	C01_I03: Public agency C01_I04: Technology firm
C02	Financial services	Facilitate the creation of cross-border trading networks.	Dissolved	Public	2016 (-2017)	C02_I01: Technology firm C02_I02: Business partner	C02_I03: Technology firm
C03	E-government	Move land registry onto the blockchain.	Productive, first customers	Public / Private	2016	C03_I01: Business partner C03_I02: Legal consultancy	C03_I03: Technology firm C03_I04: Legal consultancy
C04	Pharmaceutical	Track and Trace pharmaceuticals.	Product Prototype	Private	2017	C04_I01: Technology firm C04_I02: Business partner	C04_I03: Business partner
C05	E-commerce / logistics	Improve cross-organizational processes.	Product Prototype	Private	2018	C05_I01: Business partner C05_I02: Technology firm	C05_I03: Business partner
C06	Energy	Enable the trading of energy.	Product Prototype	Public	2018 (-2021)	C06_I01: Academic partner C06_I02: Technology firm	C06_I03: Business partner
C07	Logistics	Create paperless international distribution chain and improve the monitoring of freight.	Product Prototype	Private	2016	C07_I01: Technology firm C07_I02: Business partner	C07_I03: Business partner
C08	Healthcare	Bring medical data onto the blockchain.	Product Prototype	Public	2016 (-2019)	C08_I01: Coordinator C08_I02: Technology firm	C08_I03: Legal consultancy C08_I04: Business partner
C09	Trade finance	Improve financial trading services.	Dissolved	Private	2017 (-2018)	C09_I01: Business partner	C09_I03: Business partner

						C09_I02: Business partner	
C10	Healthcare	Improve the medial prescription process by reducing administrative barriers.	Product Prototype	Private	2018	C10_I01: Business partner C10_I02: Business partner	C10_I03: Business partner
C11	Pharmaceutical	Track and trace pharmaceuticals including temperature tracking.	Productive, first customers	Private	2016	C11_I01: Technology firm	C11_I02: Technology firm
C12	Financial services	Gather knowledge and share best practices among members.	Product Prototype	Private	2017	C12_I01: Business partner	C12_I02: Technology firm
C13	E-government	Digitize land registries.	Product Prototype	Private	2016	C13_I01: Technology firm	C13_I02: Technology firm
C14	Food supply chain	Track and Trace food.	Productive, first customers	Private	2018	C14_I01: Technology firm	C14_I02: Business partner
C15	Financial services	Develop a market ecosystem for digital assets.	Product Prototype	Private	2019	C15_I01: Business partner C15_I02: Technology firm	C15_I03: Business partner
C16	Energy	Create a marketplace to enable the trading of small amounts of energy.	Product Prototype	Public	2018	C16_I01: Business partner	C16_I02: Academic partner
C17	Trade finance	Improve efficiencies and reduce fraud in trade finance.	Productive, first customers	Private	2018	C17_I01: Blockchain platform C17_I02: Business partner	C17_I03: Business partner
C18	Mobility	Integrate different mobility-as-a-service solutions.	Product Prototype	Public	2017	C18_I01: Business partner	C18_I02: Academic partner
C19	Trade finance	Create a secure and transparent trading environment.	Productive, first customers	Private	2017	C19_I01: Blockchain platform	C19_I02: Business partner

Table 28. Overview of Studied Consortia

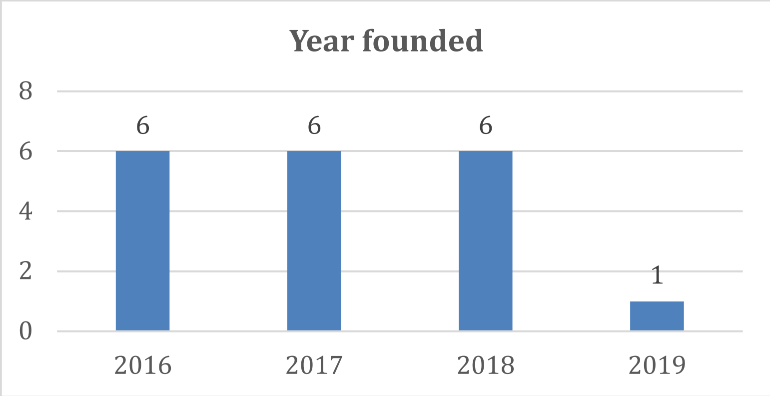

Table 29. Consortia by Founding Year

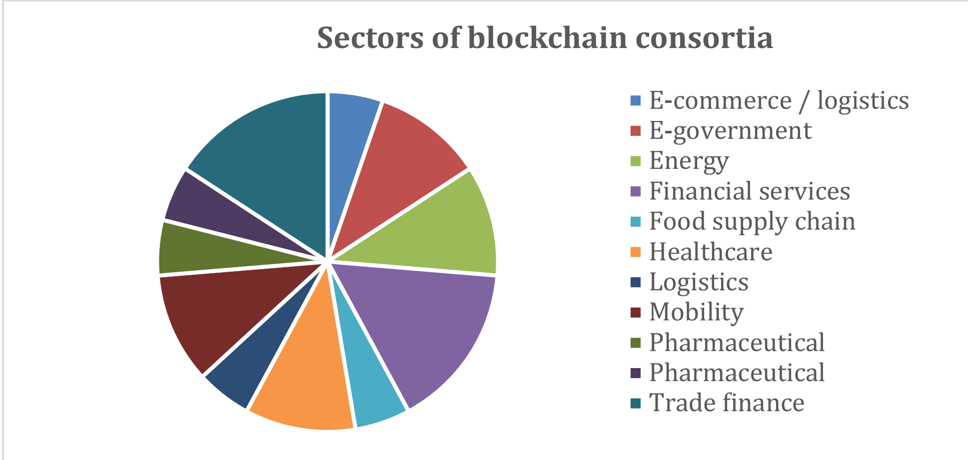

Table 30. Sectors of Studied Blockchain Consortia

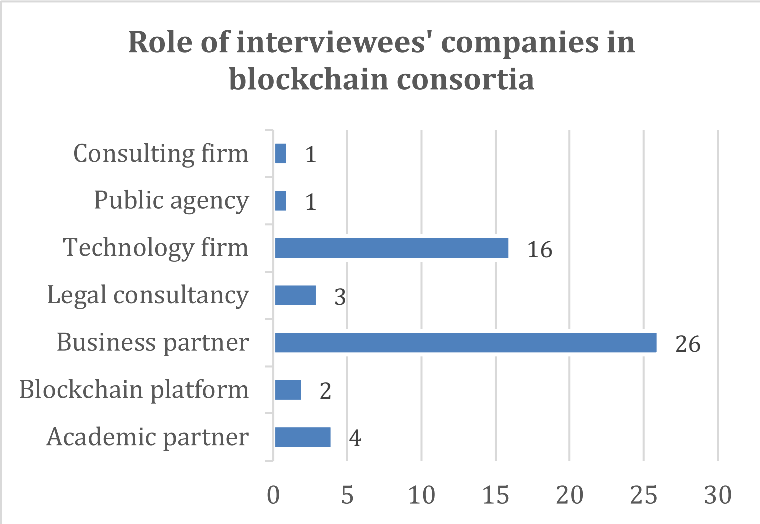

Table 31. Interviewees' companies' role in Consortium

8.4 Challenges Within Blockchain Consortia and How They Were Met

In the following, we inspect internal challenges observed within our studied consortia.

8.4.1 Between Hierarchies and Networks: Governance in Consortia

How consortia were organized and what measures for governance were applied is considered crucial for consortia success. Our findings highlight several challenges/conflicts, which we will detail in the following.

Blockchain projects within consortia cannot be managed like internal projects. Interestingly, we saw in in several consortia in our study that project management artefacts and methodologies, such as clearly defined milestones or clear responsibilities, in blockchain consortia were not followed as rigorously as one would have expected. This is surprising, as most of these consortia were built by experienced managers, who in their parent-companies adhere to rigid project management processes and practices. At the same time, however, regulatory and operational risks were perceived as greater than other projects within their parent-company's portfolio. One reason of this might be that such a blockchain consortium, naturally, can be characterized as more complex as more parties or individuals are involved. This finding is even more surprising, as the lack of rigor in project governance and structure has often been mentioned as a key challenged in the analyzed consortia. So, where does this problem originate? Methodologies around portfolio and project management are highly utilized within companies to assure project success. These methodologies work within organizations - in hierarchical settings -, where tasks can be delegated, and authority can be applied. These mechanisms change when interorganizational networks are considered. In interorganizational networks, this formal authority cannot be applied as, typically, no organization is superior to the other. Even if a central party delegates work to others, others may choose only to conduct these, if the benefits exceed one's costs.

Even though one cannot enforce authority in interorganizational networks, one can create a structure, which allows the consortia's project to succeed. Within our studied consortia, we have observed several challenges, which help them in succeeding, most prominently: consensus, fairness, and transparency. As for consensus, we have seen in the majority of consortia that a consensus-oriented decision-making is not only in place, but a cornerstone of their collaboration (C01, C04, C05, C06, C10). In these decision-making processes, often there has been a one-man-one-vote principle (C01) applied, even though partner companies varied in size, hence, negotiation power – a common theme in interorganizational networks. Several of our interviewees thereby emphasized the terms "consortium of equals" (C08) or the importance of a "give and take mentality" (C10). The latter makes the concept of fairness important. Naturally, a blockchain consortium can only succeed if all parties contribute. This opens up the question on how to measure one partner's contribution to the consortium, and in more specific, how to sanction these members, who do not contribute. Lastly, transparency of actions and decisions has been emphasized as a cornerstone of their collaboration. Several consortia mentioned that they placed special emphasis on documenting and disseminating progress in form of meeting minutes or the likes, so that it was always transparent, what is happening inside the consortium. Consequently, we formulate recommendation R1 as follows:

R1: Manage through culture. Within a blockchain consortium, you are a primus inter pares at best. So, instead of trying to enforce top-down project management methodologies, manage your project through a culture of consensus, fairness, and transparency of actions.

Democratic inclusiveness does not lead to hierarchical efficiency. When analyzing our studied consortia, we also observed several patterns of organizing within these consortia. One noteworthy component of organizing has been to find the right balance between strong leadership and equal partnerships, which Zavolokina et al.[94] labeled the tension between hierarchical efficiency and democratic inclusiveness. To be more specific: while strong leaders have appeared to be a key challenge for good progress, their centrality, and the resulting inequality within the consortium, might discourage other consortium members from continuing to contribute. This does not mean that central parties are to be discouraged in general, as also Beck et al.[95] note by pointing out the importance of a so-called "benevolent dictator" in early platform lifecycle stages. However, several consortia mentioned that specific parties should not be central because of various matters, such as own interests (platform providers) or competition with other parties within the consortium. Having neutral parties, such as universities, governmental agencies, or outsiders (e.g., consultancies), which we will detail below, proved for some of our studied consortia very successful, as these neutral parties act as integrator among the other various parties. Also, having strong individuals as consortium

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94 See Zavolokina, L., Ziolkowski, R., Bauer, I., and Schwabe, G. 2020. "Management, Governance, and Value Creation in a Blockchain Consortium," MIS Quarterly Executive (19:1). (https://aisel.aisnet.org/misqe/vol19/iss1/3).

95 See Beck, R., Müller-Bloch, C., and King, J. 2018. "Governance in the Blockchain Economy: A Framework and Research Agenda," Journal of the Association for Information Systems (19:10), pp. 1020–1034. (https://doi.org/10.17705/1jais.00518).

leaders has been frequently mentioned as a key challenge for achieving results. The way the work is divided in these consortia also played a vital role: several of our studied consortia separated (strategic) decision-making from operational decision-making and work (C01, C02, C05, C06, C08, C10), while overall striving to organize as lean as possible (C08, C09, C10). Within the operational work, a common theme has been to organize around work-streams and to divide among technological and domain experts (C04, C01, C08). Interestingly, ideas for on-chain voting using own tokens have been disregarded by almost all consortia, even though it is a common theme in permissionless blockchains and would have increased the transparency within these consortia even further. The discretion, which it entails, also points towards other cases of "shadow governance", which we observed in other consortia, where members reported that a governance structure is in place, but most parties would not live by it (C01, C11). Lastly, it is important to note, that most of our studied consortia see their current organizational model as a temporary solution, as, in the long-term, an own legal body has been desired, where rules for collaboration can be specified in more detail (C01, C04, C10). Consequently, we summarize R2 as follows:

R2: Concentrate on central driving force. Keeping a blockchain consortium afloat can be tiring. So, instead of avoiding centralization in regard to decision-making or activities, rely on a driving force, which can be controlled.

Organizing on an another one's territory can constrain collaboration. As mentioned previously, several consortia mentioned that they would not want specific other parties to be too central in the consortium, even though they do not want to lead themselves. The solution presented itself as utilizing neutral parties to orchestrate and run the collaboration within consortia, which, for some of these consortia, turned out to be a crucial cornerstone for the consortium to work. In our studied cases, these neutral parties were universities, government agencies, and, at least to some extent, also technology providers and consultancies, who acted as middle-man and led consensus-finding processes. Their main advantage is thereby that they do not have direct incentives to take advantage of other consortium members, or to prefer one consortium participant over the other. Naturally, even these neutral parties have their own interests, too, for example, as in the case of universities to conduct research or to obtain grants, or, as in the case of consultancies, to obtain follow-up business, which seemed to have been, at least partially, disregarded by the other consortium members. Especially the involvement of state agencies works both ways as state agencies bring legitimation to these consortia[96]. However, state agencies also can constrain the work of a consortium as, for example, they cannot work for-profit, their actions have to be transparent and justifiable – which is difficult,

if a consortium wants to innovate ahead of others –, or favor by law any one entity over the other.

In summary, we summarize R3 as follows:

R3: Organize on neutral ground. A consortium is no man's land, and interests may clash. Strive to organize a neutral entity, who puts the consortium's well-being first over the individual interests of others.

Over-structuring of the consortium constrains its pace. We have seen in our study that, regardless of the initial setup of each of these consortia, in the long-term, upon project vision maturity, consortia decide to establish neutral ground with an own legal body, so that no flag of any other company is predominant. Such a legal body also serves as a good way to formalize basic rules, responsibilities, and accountabilities for the future collaboration, as it can also be seen on the example of the Swiss-based cardossier project[97]; these legal bodies were, most commonly in our dataset, associations or private limited companies. Consequently, we summarize R4 as follows:

R4: Get organized pragmatically. You don't end where you start: get organized quickly, because this structure won't be your last. Find a mode of collaboration, which suits your consortium best, and professionalize your consortium in a legal entity, when innovation is tangible.

8.4.2 Building Together and Path Dependency in Technology Choices

Path dependency of blockchain systems make first choices critical. Blockchain systems assure immutability and traceability of data and business functions (smart contracts). The choice of technology is, hence, crucial, as it cannot be changed easily afterwards without detriments. If changed, saved records could be compromised – as, for example, records would have to be re-encrypted, which would leave them vulnerable to manipulation for some time – , which overcomes blockchain's promise of data authenticity/immutability. Consequently,

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[96] See G. Schwabe, "The Role of Public Agencies in Blockchain Consortia: Learning from the Cardossier." Information Polity, 24/4 (2019): 437–451

[97] See Zavolokina, L., Ziolkowski, R., Bauer, I., and Schwabe, G. 2020. "Management, Governance, and Value Creation in a Blockchain Consortium," MIS Quarterly Executive (19:1). (https://aisel.aisnet.org/misqe/vol19/iss1/3).

technological choices in blockchain consortia come with a great path dependency. Being path dependent on one's technological solution marks a great opportunity for technology vendors to establish a central role for a consortium. We summarize R5 as follows:

R5: Make conscious technological choices. Be aware that every change of the system may affect the integrity of the blockchain's records and functions.

Centrality of platform providers constrains spread of know-how and technological choices. As expected, we have seen in various consortia that technological platform providers were very dominant and established themselves as central actors in the start-up phase in technical matters[98] (C01, C03, C04, C06, C09). This central role came with various benefits: for one, being at the forefront of building innovative technology, these technology providers were paid by the consortium for building the required solution, while at the same time their employees have been trained on the consortium's expense. The latter leads also, for another, to a centralization of technical knowledge, which makes consortia even more dependent on platform providers (C02). Lastly, these technology providers could enforce technological choices that would benefit them in the long-term, such as follow-up projects, up-selling of own products and services to the consortium, or building generalizable blockchain platform components, which can be sold to other clients or used in other client engagements. Consequently, the development of platform providers to become central actors has been perceived negatively by various studied blockchain consortia and constrained one's contribution to one's respective consortium. In specific, in one concrete case (C04) the consortium's technological partner strove to lock-in the consortium's members in his own ecosystem, while the other consortium members opted for inter-operability among various technological platforms. This is not to say, that, from a technical perspective, this would not have made sense; from an economic perspective, with greater economic dependence, it mattered significantly. Providers of technology thereby not only became central actors, with own interests, they became platform orchestrators. We saw several ways, how consortia avoided a too large dependence: for one, several consortia strove to enforce a competition around IT provision, by either monitoring technological developments outside of the consortium or including IT professionals from one's parent companies to co-develop and integrate – thus, also monitor the technology provider's activities – the blockchain platform. Further, one consortium introduced absence rules in technological decision-making processes, which lock out the technology provider in matters about him (C10). Lastly, several

[98] See Zavolokina et al. (2020)

consortia chose to separate IT from business decisions, with the former being superior to the latter, which forced platform providers to justify their choices, with the risk of being replaced.

To account for the possibly changing role of technology providers, and its associated consequences, we summarize R6 as follows:

R6: Counterbalance centralization of technical know-how and architectural choices. Technology platform providers, who have often become platform orchestrators, not always will have the best for the consortium in mind, while, at the same time, they become central in terms of know-how and technology architecture development

8.4.3 With Whom? The Role of Membership Selection

Choices on whom to onboard when defines a consortium's success. Membership selection has been mentioned by our studied consortia as a crucial process. That is, as blockchain consortia seem to include parties, which would have not collaborated before, because of mistrust amongst each other. Consequently, parties like competitors or regulators could constrain the consortium's progress along the way, especially in its startup-phase. Our studied consortia, thereby, very consciously chose their initial founding members, which they either knew from prior projects or consciously approached and recruited when it fit their strategy. Thereby, our studied consortia recruited rarely two companies serving the same market segment to avoid competition within the consortium, but rather focused on complementary parties, while leaving potential competitors for later recruitment; so, innovation was put first, growth later. The selection of individual members of most of our studied consortia was primarily driven by complementing skills and roles. As for skills, technological and legal expertise have been mentioned frequently. The initial member companies most frequently were selected around a tangible business use case, along the necessary relevant ecosystem roles to make the use case work. Needless to say, bringing the right companies together is an art, as we have observed that consortia struggled to achieve the next development stage often have shown missing trust between member companies. R7 summarizes our recommendation as follows:

R7: Innovate first, grow with others later. First, organize around a tangible use-case and onboard complementary skills or non-competitive stakeholders in your target ecosystem. Grow with others, especially potential competitors, later.

8.4.4 Mine, Yours, … Ours? Revisiting the Tragedy of the Commons

Division and financing of private and common goods. As for the last internal challenge, we have observed the consortium members frequently to validate the question of "what's in it for me". It is thereby important to understand the nature of these consortia, as most of them started as innovation projects with rough goals, which also changed over time, which might render an initial business idea – and possible benefits for one consortium party – unsuited. Consequently, there is a problem around private interests, pursued by an individual member company, and the common goods, which refer to consortia's goods, which revisits the so-called "Tragedy of The Commons", which was addressed by the Nobel-Prize-winning work of Ostrom[99]. More precisely, as seen in the cases C01, C05, and C08, the goal is to develop a common blockchain infrastructure on top of which then several use cases can be deployed. Dealing with a common infrastructure regards the division between common (shared) and private goods. A core challenge thereby refers to the potential privatization of benefits, while costs are socialized. In other words: consortia necessitate commons, e.g., a running infrastructure and basic functionalities like an identity and access management, which are necessary for most of the consortia stakeholders, for which, however, nobody wants to pay; especially, if they are not primarily for common use. From a temporal perspective, stakeholders of blockchain consortia are incentivized to wait for others to develop commons. Furthermore, it can be thought of that stakeholders could incentivized to specify certain functionalities, which were thought for own use, as commons, because there all parties would share the costs. So, how can consortia deal with this? One common way is to introduce transaction costs upon infrastructural usage, which is utilized by most public and permissionless blockchains such as Bitcoin or Ethereum. More advanced concepts, as also mentioned by C01, could include a tax scheme, which assigns weights for usage, development, or adaption of the infrastructure and its functionalities. This would allow to discriminate between "light" and "heavy" usage, development, or adaption to achieve a fair distribution of costs. Thereby, it is of course necessary to assign clear property rights to both commons and private goods, so that taxations can be paid out accordingly. Furthermore, it would be necessary to assign the responsibility of proving the function in question to belong to the commons to these parties who wish to build something for themselves.

In summary, we propose recommendation R8 as follows:

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[99] See Ostrom, E. 1990. Governing the Commons: The Evolution of Institutions for Collective Action, The Political Economy of Institutions and Decisions, Cambridge; New York: Cambridge University Press.

R8: Enforce a division between private and common goods. Not every component of a blockchain system must be commonly developed or financed. To achieve fairness, divide between common and private goods and structure their use and financing accordingly.

8.5 Challenges External to Blockchain Consortia and How They Were Met

While conflicts among consortium members are a point of concern, tensions can also arise between the consortium and its environment. These tensions emerge because certain environmental challenges impact and shape consortia. To better understand these challenges, we looked at existing theoretical frameworks (see appendix A), such as the well-known PESTEL (covering the dimensions of Political, Economic, Social, Technological, Environmental, Ethical, Legal), and adapted them with the goal to identify which challenges exist, to determine whether a challenge is particularly relevant to blockchain consortia and to examine how blockchain consortia reacted to these challenges. We eventually identified more than 20 different challenges, ranging from challenges situated in the legal landscape, that can be easily identified as being external, to challenges that could be argued to be internally located, such as the culture of the involved member firms. In the following, we will present these challenges that, to us, seem to stand out when talking about blockchain consortia, measured along their mentions and empirical depth.

8.5.1 Legal: The Problem with Knowns and Unknowns

Naturally, blockchain consortia are obliged to follow laws and regulations like any other firm or consortia. However, current regulations lag behind the technological advancements and can restrict blockchain projects[100], most famously regulations around initial coin offerings (ICOs) or tokens in general. At the same time certain regulations actually already exist and might stand in conflict with certain aspects of the technology (i.e. GDPR[101]). A study by Deloitte[102], which analyzed blockchain projects, saw that a third of survey respondents were

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[100] See Koster, F., and Borgman, H. P. 2020. "New Kid On The Block! Understanding Blockchain Adoption in the Public Sector," in Hawaii International Conference on System Sciences, p. 10.

[101] See Finck, M. 2019. "Blockchain and the General Data Protection Regulation: Can Distributed Ledgers Be Squared with European Data Protection Law?," European Parliament. (https://data.europa.eu/doi/10.2861/535).

[102] See Pawczuk, L., Massey, R., and Holdowsky, J. 2019. "Deloitte's 2019 Globald Blockcahin Survey - Blockcahin Gets down to Business," Deloitte Insights.

held back by regulatory issues. In addition, the same study found that about 2/5 of respondents cited to consider the possible involvement in regulatory matters, when joining a consortium. This shows the importance of regulatory issues for blockchain projects. Looking at our own interview data, we found that the legal knowns such as antirust as well as privacy and data protection regulations, paired with the legal unknowns, caused by the current lack of regulations, are specific concerns for consortia participants.

Dealing with legal knowns is costly. While firms and consortia have to deal with regulations specific to their respective industry, there seem to be two types of regulations that are of particular interest. The first being privacy and data protection regulations. With governments implementing stricter rules such as the GDPR, these types of laws become increasingly important to blockchain consortia. Even more so since certain aspects of the GDPR can clash with the general notion of blockchain systems, if not appropriately managed. For example, blockchain's immutability characteristic stands in contrast to GDPR's right-to-be-forgotten, which allows individuals to request the deletion of one's personal data. Another example refers to the decentralization of nodes – meaning a decentralization of stored data – , which exacerbates data protection, even if data is encrypted on each of these nodes. The consortia underlying our study try to adhere to these regulations by for instance anonymizing data, deliberately choosing a privacy friendly blockchain, putting regulatory rules into smart contracts, or storing personal data per default off-chain (off the blockchain).

In addition, a consortium is made up of members from different firms, that sometime compete with each other. Consequently, questions regarding antitrust matters arise. Based on our interview data, we identified that antitrust regulations, in the context of blockchain consortia, regulate with who members are allowed to collaborate and to which degree. For instance, these laws might restrict which kind of data members are allowed to access or what kind of information can be exchanged in consortium meetings. Obviously, managers of blockchain consortia need to be aware of these regulations and manage them appropriately to guarantee law adherence. When dealing with antitrust or privacy and data protection regulations, as well as when being confronted with other types of regulatory requirements, such as specific industry regulations or regulatory differences between jurisdictions, many of our interview partners pointed out to actively seek collaboration opportunities with policy makers. Relying on such a collaborative approach also allows the consortia to potentially shape regulations in their favor, which is especially true if regulations are not fully established yet. From all of the above we draw the conclusion that legal knowns are in fact a major area of concern for blockchain consortia and should be properly managed. Thus, manager should lawyer up and be aware that while blockchain is new, not every legal problem is. Manager should seek collaboration opportunities with regulators and experts to solve immediate legal problems early on. Other legal challenges can be ignored if they currently don't apply (i.e. Right to be forgotten if the project is in a very early stage and doesn't serve real users just yet). While this might allow the consortia to be a fast mover in the early stages, neglecting such legal challenges might pose a threat later on. Immediately addressing future legal challenges or postponing them can both be valuable approaches, but one should minimize the later. Overall, manager should collaboratively lawyer up by addressing the immediate legal knowns and make an informed decision about timely addressing future legal issues.

Consequently, we summarize recommendation R9 as follows:

R9: Lawyer up. The blockchain field is new, not every legal problem is. Working early with regulators or legal experts might prevent you from early – and costly – mistakes.

Blockchain technology creates legal unknowns. As hinted at previously, many laws and standards are still emerging and thus are not set in stone. For example, we have seen that regulators are working on how to treat blockchains regarding matters of data privacy. Similarly, as for the case of data markets, blockchains necessitate clear data ownership, which is a matter far from being resolved[103]. Consequently, with regulations lacking and quickly evolving, we identified a feeling shared among many interview partners that has rather negative connotations: uncertainty. While we saw that consortia use the previously mentioned collaborative approach to fight this uncertainty, it remains unsure if that sentiment will go away anytime soon, given the fast-evolving blockchain space. As such, we see it as crucial that managers of blockchain consortia are comfortable in collaboratively navigating through an ever-evolving landscape that lacks legal guidelines. A dominant strategy along the studied consortia has been to collaborate with legal experts and regulators as early as possible, if required for one's use case, to avoid costly system redesigns later on. Thus, with some blockchain properties not being regulated yet, most famously blockchain tokens, which could be used, among others, for payments, services, funding, or governance, we conclude that managers should collaborate early with regulators and legal experts to path their own way, as summarized in R10 as follows:

R10: **Embrace the unknown collaboratively.** Some blockchain properties are not regulated, yet, most famously blockchain tokens. Collaborate early with regulators or legal experts; together you can shape regulation.

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[103] See See Zavolokina, L., Ziolkowski, R., Bauer, I., and Schwabe, G. 2020. "Management, Governance, and Value Creation in a Blockchain Consortium," MIS Quarterly Executive (19:1). (https://aisel.aisnet.org/misqe/vol19/iss1/3).

8.5.2 The Role of Trust: Trusting the Trustless

In our study we found that consortia have to consider two manifestations of trust. For one, there might exist a general lack of trust among industry participants. In addition, the consortium itself needs to be trusted by potential user and customers.

Consortium stakeholders do not necessarily trust each other. According to statements from interview participants, many consortia seem to operate in an industry where trust is generally lacking. Some see this lack of trust as a prime use case to introduce a blockchain solution, since what you do on the blockchain "*… cannot be altered, corrupted, or manipulated by government officials or by any other party.*" (C03_I03, Pos. 51-53). While this immutability seems to be a major enabler of trust, it is not the only characteristic of blockchain that has been mentioned in this context. More extreme, using a blockchain-based solution is often cited to completely remove the need to trust a third party, as, depending on the implementation, one has to only trust the consensus-algorithm. This stance may be considered misleading, as one has to trust the system providers and maintainers, to say the least[104]. With blockchain technology promising new ways of data storage and transaction, various consortia have seen blockchain as a precondition for enabling trust. While these prospects are pursued by other blockchain projects, such as formalizing organizational processes in smart contracts, most of our studied consortia do not plan to utilize their blockchains beyond data storage as, for example, tokens or voting. Nevertheless, we argue that managers of consortia that see themselves confronted with a lack of trust among consortium members can leverage the blockchain technology in order to trust the trustless, as we summarize in R11 in the following:

R11: Use and trust the trustless. Utilize blockchain's prospect to meet trust challenges, where possible.

A consortium's customer does not necessarily trust the consortium. However, trust among current and potential consortium participants is only one of two areas of trust that should be considered by managers. The second being that, aside from the within-consortium trust, our consortia also mentioned the importance of customer trust, who has to trust the operations and data within the consortium to function as described. Hence, we recommend that in addition to the trust within, managers should also address customer trust,

[104] See Miscione, G., Klein, S., Schwabe, G., Goerke, T. M., and Ziolkowski, R. 2019. "Hanseatic Governance: Understanding Blockchain as Organizational Technology," in ICIS 2019 Proceedings, Munich, Germany, 15 December 2019 - 18 December.

which can be achieved similar to above. Trust in the consortium directly can also be increased by relying on a blockchain solution, as well as making its inner-working transparent, from an organizational and technical perspective[105]. Consequently, we formulate recommendation R12 as follows:

R12: Work towards establishing customer trust. Be transparent to your clients, e.g., in how the consortium works and where records are kept and secured.

8.5.3 The Duality of Hype

The hype surrounding cryptocurrencies in 2017 and 2018 brought a lot of attention to the blockchain space[106], while causing many misconceptions at the same time. That blockchain consortia specifically are affected by hype has previously been shown in a study[107], which found that hype can be beneficial or hindering when pursuing blockchain projects. Similarly, our study found further evidence for this duality and highlights the power of hype to shape how blockchain projects are perceived. Based on our analysis, three pillars dealing with the duality of hype have been identified. While all of them can be important for regular projects too, we identified them as being especially important for blockchain consortia, due to the sheer amount of hype the space experienced, which, for example, manifested in misconceptions around blockchain technology and cryptocurrencies and consequential environmental damages the latter may cause.

Blockchain hype leads to misconceptions. We have seen impacts on the consortium's marketing in several analyzed consortia, where we found that the impacts of hype can negatively and positively impact the marketing efforts of blockchain consortia. Consortia that perceived hype as something beneficial started to explicitly point out the blockchain nature of their consortium and corresponding project. However, for others, the hype surrounding cryptocurrencies and ICOs was perceived to generate skepticism towards the technology. In this case we identified that staying away from buzzwords (i.e., using the term DLT instead of just blockchain, or not mentioning blockchain at all) can aid the marketing efforts. These two approaches stand in stark contrast to each other and indicate how hype can shape the

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105 See Zavolokina, L., Zani, N., and Schwabe, G. 2019. "Why Should I Trust a Blockchain Platform? Designing for Trust in the Digital Car Dossier," International Conference on Design Science Research in Information Systems.

106 See Pawczuk, L., Massey, R., and Holdowsky, J. 2019. "Deloitte's 2019 Globald Blockcahin Survey - Blockcahin Gets down to Business," Deloitte Insights.

107 See See Koster, F., and Borgman, H. P. 2020. "New Kid On The Block! Understanding Blockchain Adoption in the Public Sector," in Hawaii International Conference on System Sciences, p. 10.

perception both, negatively and positively. As such, we see it as crucial that managers are aware of the current position within the hype cycle and identify whether relevant stakeholders belong to skeptics or enthusiast in order to specifically tailor their marketing approach. While deliberately choosing the right vocabulary helps, we additionally recommend that managers take an active role in addressing misconceptions and making the consortium's work transparent. In summary, we formulate recommendation R13 as follows:

R13: Communicate work and purpose effectively. Make the consortium's work and purpose transparent to not be associated with possibly doubtful blockchain developments.

Employee's attitude towards blockchain can help and constrain. Similar to how hype can impact marketing, we found that it can also affect employees' motivation to contribute to a blockchain project pursued within a consortium. Those projects can be considered innovation projects. Hence, they provide employees with an opportunity to engage with a new technology that has received enormous attention as well as to identify and shape new business opportunities. Some of our interviewees mentioned their fascination with blockchain technology, e.g., an interest in cryptocurrencies not related to their day-to-day work, as a reason to contribute to a blockchain consortium. While blockchain consortia face many collaboration-related hurdles because of the interorganizational nature of those projects, e.g., due to different organizational routines, different "speeds" and different vocabularies, a fascination with blockchain and innovation can, to some extent, work as the glue that binds a project team together and helps them overcome certain issues. This is not to say that only employees fully embracing blockchain technology should be onboarded: critical, but constructive employees can have a positive influence on the consortium's work by grounding the consortium's aspirations in facts instead of visions. On the contrary, some employees may not see a benefit at all and rather want to "(…) *focus on real things that add value (…)*" (C04_I02, Pos. 29) instead. Thus, being aware of employees' perception of and attitude towards blockchain is crucial to putting a successful team together. Therefore, we recommend that managers deliberately choose who they put on the project, as enthusiasm pushes the work forward and skepticism regarding the technology allows to consistently reassess the status quo, as summarized in recommendation R14 below:

R14: Find the right mix of employees. Enthusiastic employees can be key drivers for blockchain projects, while forced participation can be a showstopper. Find the right mix along enthusiasm and constructive criticism.

Overselling prospects of blockchain technology does more harm than good. One central aspect about hype is its power to influence expectations. Some interview participants mentioned that the management board of their respective firms were actually expecting that the firm conducts a blockchain project. Support from management can make or break projects. As such, management showing interest and expecting a project can be seen as an enabler for blockchain consortia. However, we also found that the hype can generate expectations that eventually end up being unrealistic and thus remain unfulfilled, requiring blockchain consortia to spend time and resources to manage these expectations. Therefore, we recommend that manager focus on balancing expectations. The expectation should be high enough gain support and be able to push the project forward, but it should not become a burden. While this can be achieved similar to the above marketing approaches by using the right vocabulary, addressing misconceptions and being transparent, we further add that manager should refrain from firing silver bullets by overselling their project. Consequently, we formulate R15 as follows:

R15: Manage internal expectations. Expectations towards blockchains inflate quickly. While inflated expectations might secure you an innovative project, they do not necessarily advance your career.

8.5.4 Competition – Friend or Foe?

With a growing interest in the blockchain space, more and more firms pursue blockchain projects, resulting in some of them ending up in a consortium. We found that some consortia experience competition as a threat, as a benefit or are even split between the two.

Utilized technology might be outdated, as blockchain technology evolves. While some of our interview partners mentioned the existence of competitors in their space, they did not seem to be too concerned about the impacts the competition could have on their respective projects. Others however, mentioned issues like a race among consortia to publish press releases or potential customers not being able "*to decide what platforms to join*" (C18_I02, Pos. 227). This being due to the sheer number of projects potential users can choose from, resulting in them waiting and eventually deciding for the platform that survives. Hence, with numerous, potentially market-segment or technology-wise competing projects being started each day, we recommend that managers continuously scan the market to anticipate new entrants or technological advancements. Consequently, we formulate recommendation R16 as follows:

R16: Monitor the market. The blockchain domain is vibrant and new blockchain projects continue to be initiated. Technological advances might render yours outdated, so be aware of these.

Competing consortia might overtake yours, business- or technology-wise. In addition to perceiving competition as a threat some consortia take a more collaborative approach. We identified that consortia decided to join forces, if their overall project goal appears similar "*… because why reinvent the wheel?*" (C08_I03, Pos. 170). We also saw that consortia can get inspired by solutions that are already working for other consortia or let other consortia do the heavy lifting and profit from them (i.e., letting others to drive the regulatory advancements). Thus, we recommend that managers do not strictly regard competition as something that can hurt the consortium going forward. Rather, as stated before, the competition should be monitored, and collaboration opportunities actively sought for in order to learn from mistakes, adopt best practices and band together where applicable, as we summarize in recommendation R17 below:

> ***R17: Learn from or with others.*** Be aware of these blockchain consortia, who are proximate to you, technology- or business-wise. Study their solutions to avoid their mistakes, and, in the best case, partner up with them, and learn together.

Table 32 below summarizes all of our empirically validated recommendations along their corresponding challenges, areas, and perspectives.

Perspective	Area	Challenge	Recommendation
Internal	Governance	Blockchain projects within consortia cannot be managed like internal projects.	***R1: Manage through culture.*** Within a blockchain consortium, you are a primus inter pares at best. So, instead of trying to enforce top-down project management methodologies, manage your project through a culture of consensus, fairness, and transparency of actions.
		Democratic inclusiveness does not lead to hierarchical efficiency.	***R2: Concentrate on a central driving force.*** Keeping a blockchain consortium afloat can be tiring. So, instead of avoiding centralization in regard to decision-making or activities, rely on a driving force, which can be controlled.
		Organizing on an another one's territory can constrain collaboration.	***R3: Organize on neutral ground.*** A consortium is no man's land, and interests may clash. Strive to organize a neutral entity, who puts the consortium's well-being first over the individual interests of others.
		Over-structuring of the consortium constrains its pace.	***R4: Get organized pragmatically.*** You don't end where you start: get organized quick, because this structure won't be your last. Find a mode of collaboration, which suits your consortium best, and professionalize your consortium in a legal entity, when innovation is tangible.
	Building Together	Path dependency of blockchain systems make first choices critical.	***R5: Make conscious technological choices.*** Be aware that every change of the system may affect the integrity of the blockchain's records and functions.

		Centrality of platform providers constrains spread of know-how and technological choices.	***R6: Counterbalance centralization of technical know-how and architectural choices.*** Technology platform providers, who have often become platform orchestrators, not always will have the best for the consortium in mind, while, at the same time, they become central in terms of know-how and technology architecture development.
	Membership	Choices on whom to onboard when defines a consortium's success.	***R7: Innovate first, grow with others later.*** First, organize around a tangible use-case and onboard complementary skills or non-competitive stakeholders in your target ecosystem. Grow with others, especially potential competitors, later.
	Commons	Division and financing of private and common goods.	***R8: Enforce a division between private and common goods.*** Not every component of a blockchain system must be commonly developed or financed. To achieve fairness, divide between common and private goods and structure their use and financing accordingly.
External	Legal	Dealing with legal knowns is costly.	***R9: Lawyer up.*** The blockchain field is new, not every legal problem is. Working early with regulators or legal experts might prevent you from early – and costly – mistakes.
		Blockchain technology creates legal unknowns.	***R10:* Embrace the unknown collaboratively.** Some blockchain properties are not regulated, yet, most famously blockchain tokens. Collaborate early with regulators or legal experts; together you can shape regulation.
	Trust	Consortium stakeholders do not necessarily trust each other.	***R11: Use and trust the trustless.*** Utilize blockchain's prospect to meet trust challenges, where possible.

		A consortium's customer does not necessarily trust the consortium.	***R12: Work towards establishing customer trust.*** Be transparent to your clients, e.g., in how the consortium works and where records are kept and secured.
	Hype	Blockchain hype leads to misconceptions.	***R13: Communicate work and purpose effectively.*** Make the consortium's work and purpose transparent to not be associated with possibly doubtful blockchain developments.
		Employee's attitude towards blockchain can help and constrain.	***R14: Find the right mix of employees.*** Enthusiastic employees can be key drivers for blockchain projects, while forced participation can be a showstopper. Find the right mix along enthusiasm and constructive criticism.
		Overselling prospects of blockchain technology does more harm than good.	***R15: Manage internal expectations.*** Expectations towards blockchains inflate quickly. While inflated expectations might secure you an innovative project, they do not necessarily advance your career.
	Competition	Utilized technology might be outdated, as blockchain technology evolves.	***R16: Monitor the market.*** The blockchain domain is vibrant and blockchain projects are started every day. Technological advances might render yours outdated, so be aware of these.
		Competing consortia might overtake yours, business- or technology-wise.	***R17: Learn from or with others.*** Be aware of these blockchain consortia, who are proximate to you, technology- or business-wise. Study their solutions to avoid their mistakes, and, in the best case, partner up with them, and learn together.

Table 32. Matching Observed Challenges with Recommendations

8.6 Concluding Comments

Blockchain consortia continue to attract interest from research and practice. In how far these projects will be realized remains unclear, as the field of application of blockchain technology beyond cryptocurrencies must be considered novel. To navigate through these “novel” waters, and to make sure that platforms these consortia develop have a higher chance to survive and eventually thrive, in this article, we strove to understand blockchain consortia’s potential challenges in their early stage of development. We have provided insights of the challenges perceived by a variety of blockchain consortia, and how these challenges were dealt with, in order to develop generalizable insights, along the internal (in our study: governance, mediating, building together, membership, and commons) and external (in our study: legal, trust, hype, and competition) perspective of a consortium.

Blockchain systems are seen by various researchers and practitioners as enablers of interorganizational collaboration, potentially even allowing for new ways of interacting in businesses. These are high claims, which might have been proven right for cryptocurrencies in regard to the free-and-open-source mode of production they originated from. However, these claims may be unwarranted for blockchain consortia, as these types of organizations rely on principles of governance inherent to a network, meaning, at least to a certain extent, on trust and reciprocity; in how far blockchains may help here remains to be seen, and we believe this to be a fruitful future research avenue. We encourage researchers to study interorganizational networks and potential blockchain-based systems these want to develop closely for both novelties blockchain technology may bring to the organization and governance of these consortia themselves and the difference of blockchain prospects between cryptocurrencies and blockchains as interorganizational systems.

8.7 Appendix: Research Methodology

Within this research, we conducted a multiple-case study including 53 qualitative semi-structured interviews with key members of 19 consortia in various industries, such as banking, healthcare, automotive, and public services. To assure a thorough understanding on each of these consortia and achieve internal validity of our findings, we interviewed 2-3 stakeholders per consortium. The interviews, which had an average length of 75 minutes, were conducted between February and September 2019. Overall, we were able to obtain more than 60 hours of audio material. The interviews were conducted in a semi-structured fashion (Myers & Newman, 2007), utilizing a detailed interview guide, which covered (simplified) a consortium's business model, technological architecture of their aspired solution, regulatory challenges, as well as their mode of governance and collaboration. The interviews were transcribed verbatim and coded along the topics of the interview guideline. The coding results, as well as observations made in these workshops, which helped us refine our findings, were discussed during several workshops within the team of researchers and practitioners who participated in the data collection and analysis. Embedded into this larger project, within this study, we coded the interview material based on categories relating to the consortias' proximate and external environment. Even though we have obtained a sizeable and multifaceted dataset, we note that our dataset is qualitative in nature and represents a snapshot of the state of blockchain consortia at specific points in their time. As a consequence, rather than drawing general conclusions on causal effects from our findings, our study provides well-grounded and actual insights into blockchain consortia management. More concretely, our insights about blockchain peculiarities were cross-checked with other interviews and empirical materials. Our findings and final recommendations also relate to theories, were deemed necessary.

Part IV: Blockchains As New Modes Of Governance?

9 PAPER VIII: Tribal Governance: The Business of Blockchain Authentication

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Abstract

While information technologies are increasingly exceeding the boundaries of organizations, governance in relation to IT is gaining centrality for research as much as for practice. Based on interviews with representatives from blockchain companies and content analysis of grey literature, we discuss established idealtypes of governance against the rivalry that cryptocurrencies and blockchains bring to digital settings. We pay special attention to authentication functions and the empirical domain of land registries. After referring to market, hierarchy, network and bazaar, we conclude outlining the prospects of a different governance mode called 'tribal' that better captures the 'togetherness' which rivalry originates.

9.1 Introduction

If one copies and distributes music, it is still music. If one can copy and distribute money, it is not money anymore. Cryptocurrencies like Bitcoin proved at scale blockchain functionalities, which introduce rivalry into digital environments via distributed authentication. This capacity of authentication is relevant for governance purposes because it introduces a sense of togetherness due to shared interest.

Rather than grounded theorizing, this article aims at problematizing an existing typology of modes of governance, initiated by Williamson (1985) and Powell (1990), on the basis of the emerging phenomenon of blockchains. More precisely, the bazaar governance (Demil & Lecocq, 2006), which formalizes digital governance defined by openness and non-rivalry of information goods and exemplified by FOSS, is considered under the light of blockchain architectures.

The bazaar mode of governance, usually identified to digital modes of production (Demil & Lecocq, 2006; Raymond, 1999), assumes the non-rivalry of information goods. Thus, we argue, it misses relevant aspects of blockchain-related phenomena. On the basis of this mismatch and illustrations from empirical domains, we propose a different mode of governance which we name 'tribal'. The reference to tribes accounts both for a mode of governance not defined by the rule of law, and for the togetherness that rivalry introduces into the open and common pastures of the digital fields.

In the research domain about governance *through* IT, as distinct from governance *of* IT, this paper looks at the former and takes a narrow focus on authentication. Authentication is here intended in its basic meaning of certification of genuinity. Against the background of information openness and abundance, typical of open information infrastructures, we claim that the major information management innovation introduced by blockchain - and proved viable at scale by Bitcoin - is distributed authentication. We illustrate it relying on cases of actual implementations.

In open networks like the internet, the governance problem is at the fringes. Since there is no way to seal boundaries to define who is in and who is out, then to control them, open networks are constantly exposed to malicious actors. So, openness is generative both of innovations and misconducts (Zittrain, 2006). This polarization depends on architectural openness and on nearly zero marginal cost for replication and distribution, which in turn made IT unsuitable for native digital money (i.e. without external and non-digital guarantor). That is because, of course, money must not be replicable (i.e. counterfeitable).

The blockchain, the architecture underneath the successful currency Bitcoin, circumvents this limit of IT and brings rivalry into the digital environment. It proved rivalry viable by making transactions public and by letting the 51% of computing power (there are alternatives) to authenticate honest transactions. In practice, Bitcoins (or tokens more generally) cannot be replicated because authenticated transactions locate any token and differentiate it from any other. From another angle, Bitcoin tested at scale a rewarding mechanism for keeping people honest when operating on this open network. For such reasons, open (often referred to as 'permissionless') blockchains are particularly interesting for governance issues: they promise to scale easily for positive network externalities, but they are difficult to manage because of lack formal organizational structures and boundaries to police.

We place our interest in governance through blockchain against the broader background of progressive decoupling of formal organizations and large information systems (or information infrastructures). For instance, cloud computing has taken the control on IT out of IT departments' hands. Regarding blockchain, this move is well exemplified by the independence of cryptocurrencies from nation-states and central banks.

To support the claim for a new governance mode brought to the fore by blockchain implementations, the remainder is organized as follows: first we identify the cornerstones of our theoretical framework. It takes its moves from general studies on IT governance, then presents the bazaar as a recent extension of the well-established modes of governance typology by Powell (1990). We discuss the peculiarities that blockchain introduces against these established idealtypes, with a special attention to the bazaar. In particular, we highlight how the rivalry that blockchains introduce into digital environments originates a level of 'togetherness' among blockchain users that does not manifest in information goods and native digital organizing modes like free and open source software (FOSS). After presenting the main works on actual implementations of blockchains, we outline our research methodology. The paper continues with an illustration of blockchain implementations in the domain of land registries. In conclusion, we discuss a mode of governance, which we name 'tribal', that may better account for digital organizing when rivalry plays a relevant role.

9.2 Theoretical Framework

As anticipated, the new architecture introduced and tested by Bitcoin is about authenticating transactions, thus certifying the reliability of it as a public ledger. From another perspective, blockchains introduce rivalry in the online domain: to avoid the double-spending problem, each token of a currency must be identifiable and owned by someone and not anyone else at the same time. The opening example clarifies: if I pass a music file on to someone else, we both can listen to it and it remains music. Instead, if we both can own the same bitcoin, it would not work as money anymore.

The digitally native way of authenticating something introduces rivalry and constitutes a qualitative shift in digital environments. Copies are not all the same as they used to be. This is fostered by the open nature of the Bitcoin blockchain where no single node can be held accountable due to its distributed nature (Ghassan O. Karame, 2015; Raiborn, 2015). The traditional jurisdiction thereby may act as a mediating entity in case of disputes only to the extent parties accept it.

Since jurisdictions have never been intended as a service to use as one pleases, basic questions about what social contract underpins blockchain organizing forms are legit to ask. On this line, Reijers et al. (2016) take a theoretical stance and discuss blockchains against social contract theories by Hobbes, Rousseau, and Rawls. Even if this work lacks a normative dimension, it sustains the sense that blockchains originate and rely upon a degree of togetherness, which we argue throughout this work.

The term IT Governance has been used since the early 1990s (Henderson & Venkatraman, 1993; Loh & Venkatraman, 1992) and became more prominent later in the decade with the works by Brown (1997) and Sambamurthy and Zmud (1999), while IT projects grew in complexity. IT infrastructures developed into stable component of organizational IT portfolios (Weill & Broadbent, 1998), thus suitable for strategic planning. Later, IT governance was defined by Weill and Ross (2004b) as the framework for decision rights and accountabilities to encourage desirable behavior in the use of IT. In Weill and Ross's (2004b) framework, political idealtypes are used to describe how people in the enterprise make key decisions. Their quite articulated conceptualization is too precise, thus inflexible, to be applicable to blockchains, especially permissionless, which remain in constant flux, do not have actors in the position of fully exercising decision rights, nor clear mechanisms and rules to achieve objectives (a clear example is the never-ending unruly conflict about Bitcoin blocksize). So, while we maintain our focus on IT and governance, we need to move to theories that relate more to actual use.

Agre (2003), referring to the previous wave of peer-to-peer architectures originated with file sharing, instils the reasonable doubt that decentralized architectures do not necessarily match with decentralized institutions and vice versa. Especially, decentralization may not necessarily lead to equality in practice. In fact, most open projects (like the Web, Wikipedia, P2P, FOSS) showed remarkable tendencies to centralization over time (for instance O'Mahony & Ferraro (2007)).

The recent book by Musiani et al. (2016) looks at social and political sciences to account both for the elusiveness to control that the Internet and the services based on it showed to traditional decision makers, and for new ways power is being exercised through IT. In sum, the spectrum of positions about IT and governance is wide and spans from traditional managerial command and control approaches to international anarchy. Such diversity suggests that there are basic differences about the understanding of what IT are and how to govern through them. So, we turn our attention to a classic of organization studies: Powell (1990), in order to introduce and problematize the 'bazaar governance' (Demil & Lecocq, 2006).

9.2.1 From Hierarchy to Bazaar Governance

According to Williamson (1999) "governance is a means by which to infuse order in a relation where potential conflict threatens to undo or upset opportunities to realize mutual gains". Williamson (1975, 1985, 1999) studied governance structures in a comparative institutional way. The core of his theoretical development is that transactions entail uncertainty about their outcome, due to the bounded rationality and opportunism of agents. To overcome this uncertainty, and as a means of reducing transaction costs, agents implement a governance structure, which Williamson defined as "the explicit or implicit contractual framework within which a transaction is located" quoted in Demil and Lecocq (2006). This line of thinking is expanded by Watson et al. (2005) who discuss it in digital domains, with an argument consistent to Surowiecki (2005) 'Wisdom of the Crowds', informed by cases like FOSS, Wikipedia and the likes.

Table 33 is our summary of Demil and Lecocq's (2006) extension of Powell's (1990) threefold classification governance idealtypes. The last column in *italics* on the right is an anticipation of our proposal for a novel governance idealtype which we named 'tribal'. It is discussed in the last part of this paper.

Features	Explanation	Market	Hierarchy	Network	Bazaar	*Tribal*
Contract Framework	Legal framework for transaction	Classical contract [108]	Employment contract	Neoclassical contract[109]	Open license contract	*(Until now) Post-hoc: a record if/when needed*
Coordination Mechanism	Means of governing exchanges	Price	Formal line of authority	Embedded relations	Product	*Adherence to the technical protocol*
Normative basis	Main regulatory force	Market exchang es	Forbearance	Exchanges	Openness and fairness	*Consensus-based*
Identity of parties	Degree to which identity of parties matters	Irreleva nt	Irrelevant	Relevant	Partially relevant	*Pseudonym-based*
Nature of incentives	Incentives for transacting parties	Competi tion	Status	Reciprocity	Reputation	*Hoarding (for currencies) Reliability (for records)*
Incentives Intensity	Agent's motivation to contribute	High	Low	Intermediate	Low	*High*
Control Intensity	Capacity to enforce regulations	Low	High	Intermediate	Low	*Low from the outside Intermediate from inside*

Table 33. Governance idealtypes adapted from Powell (1990) and Demil and Lecocq (2006)

Powell (1990) criticized the idea that the dichotomy hierarchy vs. market could explain the variety of organizational arrangements and how they actually operate. As summarized in table 33, hierarchy refers to formal organizations within which command lines and responsibilities are defined and stable. Market refers to atomic actors who freely trade. As Williamson (1975) put it: "firms are islands of planned co-ordination in a sea of market relations." Powell picked on this dichotomy and argued that market logics may operate within hierarchies (incentives, for instance) and hierarchies onto markets. So, he proposed the network as a new idealtype, which is most suited to domains in which measurements are difficult and trust among parties has a paramount role. The concept of network accounts for arrangements that are quite common across a variety of industries like textile, construction, and media among several. Still, he wrote before IT made a dent in organizations, economy, and their governance.

Demil and Lecocq's (2006) study proposes to add a fourth idealtype, named 'bazaar governance', to Powell's (1990) tripartite categorization of governance forms—i.e. hierarchies, markets and networks. Demil and Lecocq's (2006) work, based on FOSS production, found

[108] Based on Demil and Lecocq (Demil & Lecocq, 2006): In classical contract law, transacting parties identity is irrelevant and their dependence slight.

[109] Further (Demil & Lecocq, 2006): In neoclassical contracts, hybrid organizations remain autonomous but bilaterally dependent and their identities matters.

that Powell's threefold characterization was not satisfactory to explain the then booming phenomenon of FOSS, and by extension the information economy, so they proposed the bazaar idealtype.

FOSS took the hegemony over the internet not only by ignoring much of the received wisdom about project management and how organizations should manage IT, but also projecting the possibilities of open collaboration also beyond software development. For instance, voluntary geographic information (and user-generated content more broadly) has shown that formal expert organizations are not the only way of getting things done; consumer electronics and open internet services have replaced business technologies in leading the ways of innovation; crowdfunding has unveiled the blindspots of traditional investors' preferences.

The peculiarities of digital governance are formalized by Demil and Lecocq, who relied on the initial ideas by Raymond (1999). Indeed, the label bazaar derives from Raymond's (1999) work who contrasted it to the traditional approach to software development, likened to a 'cathedral'. The bazaar mode of organization is defined by open licenses, which allow unrestricted access to the source code and prevent anyone to appropriate and trade on software ownership. This reduces substantially the transaction cost of FOSS. The consequent governance mode is based on openness and transparency, software developers build up their reputation, which they can then spend providing assistance on the software they know (Krogh et al., 2012). Overall, like in a bazaar, both direct incentives and controls are low. In fact, the bazaar clearly differs from hierarchies because there are no defined organizational structures along which command and control lines can be used to regulate behaviors. It also differs from markets because open source licenses do not grant anyone with exclusive ownership rights, thus software cannot be traded as a commodity for direct profit. Finally, it differs from networks because membership and associations are fluid, and selection does not happen at the entry points.

Demil and Lecocq conclude their work calling for extending the bazaar governance idealtype to other domains to make it more general. Since their study pinpoints to some peculiarities of digital organizing, we thought of seeing to what extend the bazaar helps explaining another rapidly emerging phenomenon: blockchains. We found strengths and weaknesses. In the first place, we find that their focus on transaction cost and copyleft as a peculiar kind of contract are reductive.

9.2.2 Authentication and Rivalry

Like any other FOSS project, the source code of most blockchain software is publicly available for anyone to check it, use it, develop and redistribute it. In spite of these apparent similarities, there are remarkable differences between open-source applications like web browsers or word processors and blockchains. Blockchains, by authenticating some data against the rest, introduce rivalry to the digital environment, which has always been characterized by replicability and plentitude. In short, before the blockchain, all copies were the same. With blockchain it has become possible to differentiate something from something else (like who owns a bitcoin) without relying on non-digital authorities. This property of the blockchains underneath cryptocurrencies is allowing to move from openness and gift economy, well exemplified by FOSS, to a digitally native economy, at the expenses of the non-rivalry that used to characterize information goods. This is a novel link between authentication and modes of governance.

Concretely, if at some point any open source web browser users is dissatisfied with the software, they can decide to fork the code and develop an independent version to fit their own and new users' preferences. When this happens, users of both versions maintain the capacity to use their software for most if not all browsing purposes. This is not the case with blockchains, whose main purpose is to guarantee the authenticity of the data they gather. When a fork takes place, data on the forked ledgers may differ and the reliability they offer be lost (see Dupont (2017)).

To clarify this point, let us consider the most developed blockchain: Bitcoin. All Bitcoin transactions are authenticated and recorded on one public ledger maintained by all miners. Because of the increasing number of Bitcoin transactions, the blockchain has been manifesting bottlenecks in authenticating all of them in a timely fashion. Some developers have proposed solving this problem by modifying the software to increase the blocksize which is currently fixed, rather arbitrarily, at 1MB. Unlike with the web browser example, this is where Bitcoin manifests substantive differences from the bazaar idealtype. Indeed, the fork of the software would create two distinct blockchains, and Bitcoins attached to one could not be traded on the other. In this case, the value of the currency would be likely to collapse. So, while forked browsers retain their use value, Bitcoins would lose use value when losing exchange value. Hence, compared to FOSS projects, public distributed ledgers show a level of togetherness that no involved actors (end users, miners, companies, regulators, etc.) can easily get away from.

These differences from FOSS are explained by the actors involved and the rules governing their relationships. Bitcoin involves a number of significant players that together guarantee its blockchain consistency across time and space. First, a relatively small group of core developers is responsible for new code. Second, a relatively large number of miners authenticate transactions so they are properly executed and no double spending is allowed. Then, there are the many users who trade in Bitcoin and may have little knowledge or interest into its underlying functioning. Still, by trading fiat money for Bitcoins, they affect massively its price level, thus the financial incentives for the first two. Therefore, even if copyleft licenses are adopted for blockchains, they are not as determinant for governance as Demil and Lecocq (2006) claim they are for other FOSS projects.

Secondly, the centrality that Demil and Lecocq (2006) accord to transaction cost economics does not seem to explain relevant aspects of blockchains. Starting from Williamson (1985), from whom also Powell moved, Demil and Lecocq (2006) pose central attention onto the transaction cost economics, which discriminates between market and hierarchy. Even though from other empirical domains, studies like Lucas and Goh (2009) as well as Garud and Munir (2008) pose doubts on emphasizing transaction cost. Trust was argued to be central in networks and bazaar. In spite of recurrent references to trustless transactions, we see it central for blockchains as well. This is explored in the following paragraph.

9.2.3 Faceless Trust

Both the network and the bazaar modes of governance exceed the hierarchical and market modes of regulation and are explanatory of cases where trust plays an important role. Trust is given paramount relevance in Powell's networks as the glue that guarantees reciprocity. Trust is a key factor and is also described as the primary governance mechanism for dyadic or network exchange relationships (Powell, 1990). Trust does not only minimize transaction costs, but also creates value (with enhanced information sharing) for such relationship (Dyer & Chu, 2003). Also the reputational nature of bazaar incentives works only to the extent participants trust a fair allocation of resources down the line.

Rivalry might make think that actors do not trust each other, nor the whole system. This stance is misleading. It is not uncommon to read claims that blockchains are trustless. This stance proves quite narrow if one considers that no one is forced to use permissionless blockchains. So, users do trust them if they continue using them, and even pour real money, also after early curiosity. In permissioned blockchain trust is, at the very least, posed in those who are in charge of policing the access points. Having said that, it is reasonable to accept that blockchain introduces a way to trade without intermediaries with unknown people, whom we may not trust individually. This is what we call faceless trust.

Trust is one of the main underlying concepts of blockchain infrastructures. We turn to Gambetta's (1988) formalization of the concept of trust, quoted by Lustig and Nardi (2015). According to him, trust is the subjective sense that one has about another performing a particular course of action, with consequences for the former, without being monitored. Trust is, therefore, there to bridge over the future uncertainty (P. Brown & Calnan, 2012).

Although trust appears central for blockchains, there are no studies yet that focus on the mutual relations between blockchains and trust. Blockchain technology refers to transfer of trust from offline to online domain, or to the emergence of trustworthy relations where there were none or weak. In contrast to classical way of perceiving trust in online relationships (Beldad et al., 2010), trust in blockchain technology does not require third-party guarantees or any third party at all. Therefore, blockchain-enabled trust can be seen as faceless, meaning that there is no actor who plays the role of a trustee. The tribal governance mode we propose may offer a framework for future studies in this direction.

When no money is exchanged as a counterpart for trades, like in gift economies, parties confide that what goes around comes around or put trust in higher ideals like the common good. The gift economy based on non-monetary transactions proved extremely successful online: it originated a plethora of initiatives, some of them – like Free and Open Source Software and Wikipedia – were so successful that the digital environment, with its bazaar governance, has been seen as a (re)surging space for the wisdom of the crowds (Surowiecki, 2005) and common-based peer production (Benkler, 2006).

Beside digital initiatives not directly mediated by money, fiat currencies found their inroads onto the internet as credit money for e-commerce. In fact, online trades are mediated by banks and credit companies, which authenticate monetary transactions and avoid double-spending. In case of online trades using credit money, banks and credit companies guaranty for lack of trust between unknown buyers and sellers.

Bitcoin (and blockchains) has allowed an interesting third way between gift economy and bank-guaranteed trades: even if no authority can reverse transactions, Bitcoin users are not left with the only option of hoping that things will turn out well; Bitcoin users can monetize goods, products and relations trusting the 51% of (Bitcoin) crowd. According to Maurer et al. (2013), a person, who uses Bitcoin, trusts it because its code is publicly available and auditable. We extend their stance highlighting that the publicity of all transactions allows for the 51% of computing power to certify all of them. Also traders, by sustaining prices, contribute to an infrastructure which is trusted. Publicity of resources makes people trust its functioning and reliability.

9.2.4 Current Research on Blockchain

In recent years, Bitcoin first and blockchains later have attracted wide-spread interest. Of course, computer scientists have been first movers to approach this emerging phenomenon and proposing many variants of the architecture concept outlined by Nakamoto (2009). Not least because of the long-time cycle of implementing IT and going through peer-review processes, we could not find much academic literature based on studies of actually implemented and used blockchains in real-life settings. Consequently, despite our keen intention of differentiating between speculations about the potentials of blockchain and actual uses, it was often difficult to discriminate between what was aimed at by designers from what was happening in practice.

Utilizing blockchains comes with the trust, or just the assumption, in algorithms and their capacity of governing organizational relations. Lustig and Nardi (2015) dive into the Bitcoin phenomenon to investigate how algorithms have gained authority and legitimation in directing human activities by defining what information we rely upon. They criticize, like Dodd (2017) does, the emic views of people promoting Bitcoin for their naive assumptions about technological neutrality and independence from corrupted politics. A similar approach can be seen in the discussion on blockchain-based state governance (Atzori, 2015; MacDonald et al., 2016). Even if we agree that algorithms are not neutral in transforming human behaviors, organizations, and societies, we find that a narrow focus on algorithms does not account for novel aspects that blockchains bring to the fore. Thus, this article takes a different starting point: the rivalry that the blockchain architecture introduces by means of authentication, which miners maintain, and users rely upon and reinforce by using blockchains. Indeed, as long as we consider algorithms solely, we would not see much difference between open source software and blockchains, and the authentication they bring about by relying on miners and traders. This distinction is expanded upon later, when limits of the bazaar idealtype are discussed and tribal governance introduced.

Studies about governance often discuss issues of jurisdiction, which remains uncertain because the responsibility for the genuity of transactions has shifted to allegedly independent miners or other consensus methods, which are located outside of formal organizations' and jurisdictions' reach and, therefore, cannot be held accountable to them (Sullivan & Burger, 2017). As a consequence, legal uncertainty in transactions increases. A way to mitigate this uncertainty are so-called smart contracts, which gained popularity as well as controversy. ‘Code is law’ – echoing Lessig’s book (Lessig, 1999) – may not to apply to law in the traditional sense.

Traditional contracts reduce uncertainty by committing all signatories, who remain subject to the rule of law. But blockchain may exceed jurisdictions, thus fall in the cracks between inconsistent jurisdictions. Dupont and Maurer (2015) reflect on the applicability of smart contracts and their relationship to law. It is claimed that distributed, autonomous, and self-executing contracts are not feasible due to their non-contractual basis. Durkheim argues: “Wherever a contract exists, it is subject to regulation, which is the work of society and not of individuals”. Smart contracts are not contracts, they are rather automatisms built on the top blockchain authentication (Quinn DuPont and Bill Maurer, 2015). Even if there a growing interest for smart contracts, we marginally consider them here since they are envisioned as a layer on the top of blockchains.

Walsh et al. (2016) conducted a literature review to first gain an overview of blockchain characteristics, a necessary step to define blockchain types. Key blockchain characteristics are: level of permission, restriction of public access to data, modes of consensus, modularity, scalability, interoperability, anonymity. Four possible types emerge: Decentralized/Extensible (Bitcoin), Decentralized/Inextensible (Counterparty), Centralized/Extensible (Ripple), and Centralized/Inextensible (R3). Empirical investigation is expected to uncover a number of operational issues associated with different types, e.g., issues of governance, political aspirations, control, risk and resistance to change from those continuing to use traditional systems.

Morabito et al. (2017) offer the most exhaustive overview of the state-of-the-art of blockchain in organizations. The salient cases presented there are Coinbase, Everledger, Factom, eHealth and electricity management applications, finance and smart-contracts. Those case studies were useful to navigate and put in perspective materials about the actual implementations we found, and to decide who to contact directly. Interestingly, blockchain architecture is believed to fit into fundamentally different domains in terms of scope or transactional volume: from land registries to supply chain management systems, from intellectual property right management to money transfers and payments. In all those domains, the incumbents are intermediaries or third party guarantors, which the blockchains aim at substituting.

We could group other contributions according to their focus on public services or private sector. From the former, a case study in healthcare by Ekblaw et al. (2016) analyzes MedRec, a system that gives patients a comprehensive, immutable log and easy access to their medical information across providers and treatment sites. Leveraging a blockchain, MedRec manages authentication, confidentiality, accountability and data sharing, all crucial considerations when handling health data.

In the private sector, certainly the most developed domain is finance, not least because of Bitcoin experience. Morisse (2015) surveys 42 papers about cryptocurrencies in terms of methods, concepts, and approaches and finds that cryptocurrencies had not reached IS research, at least in 2015. Studies on security were more receptive of this emerging phenomenon. Herbert and Litchfield (2015) research the application of property rights in the case of blockchain-based software piracy prevention. Karame et al. (2015) analyze the probability of double-spending on the Bitcoin blockchain and claim that the current Bitcoin log does not provide sufficient information to provide sufficient accountability, which would facilitate to blacklist malicious nodes.

Overall, Morabito et al. (2017) warns about the risks of privatizing state functions through blockchains as they contribute to “a process of undermining public institutions, the superiority of economics over politics, and the change of citizens into to customers (...), which perpetually empowers markets to the disadvantage of citizens”, which is in line with Atzori (2015).

9.3 Method and Data Collection

Blockchain is a new technology and only in recent years it has started to become applied outside the cryptocurrencies domain. Thus, it is time now to explore new phenomena emerging when blockchains are being applied to societal and business problems. Blockchain governance is such a new phenomenon. It is time to check whether old models of how business is conducted, organized and governed appropriately describe and explain blockchain-related governance. As typical for exploratory research (Briggs & Schwabe, 2011; Stebbins, 2001), we used all available sources to uncover interesting phenomena and derive appropriate concepts to describe them. Specifically, we reviewed the still scarce, but rapidly growing scientific body of work for reports on blockchain governance, alongside scanning more than six hundred sources for related materials.

To complement our literature review from an academic side with practitioner’s intention to use blockchains, we also analyzed 126 blockchain-based companies from a variety of online sources like Crunchbase and Coindesk for their governance characteristics. Identifying relevant cases has proved a difficult task because of the novelty of this domain and the hype that wraps it. Indeed, there are countless startups, initiatives, GitHub projects, but few running implementations, which also causes empirically grounded research to be scarce. Hence, our case collection is rather based on papers, practitioners' reports, grey literature, specialized press, blogs, as well as insights we gained from expert interviews.

We found the most advanced application domains to be (1) financial solutions, as wallets and payments, (2) digital identity of legal persons or tangible as well as non-tangible assets, and (3) infrastructure provision of data and transaction storage. In more detail, supply chains, intellectual property rights, land registries, and micro transactions are those areas where applications have been released to "the wild". While we have systematically studied a total of two dozen applications in four domains, space restrictions allow us only to describe the domain of land registries in this paper. Here, we complemented a review of practitioner-based literature with interviews with high tier executives.

Scientific publications, practitioner's reports, and the interview data were fed into an iterative sense-making process: The authors coded and conceptualized the information individually. Codes were initially seeded by using concepts characterizing established governance mechanisms (i.e. market, hierarchy, network, bazaar). These individually gathered insights were then discussed by all authors. We also exposed immediate results and sought for input from the Coding Value research project. This input was then used to revisit the data and further develop our concepts. The highest level conceptual results is depicted in table 33 above, where we contrast established governance mechanisms with tribal governance. This iterative approach was finished when theoretical saturation was reached.

9.4 Blockchain-based Land Registry

In the following, we present the business of authentication in the real-life domain of land registries. Land registry received attention at the World Economic Forum (Hutt, 2016), especially for the long time-span that they must cover. Table 34 below lists the main cases we found and their main references.

Case	**Location**	**References**
A	West Africa	(Aitken, 2016; Bates, 2016)
B	Caribbean	(Bandeira et al., 2010; Rizzo, 2015; Snow et al., 2014)
C	Scandinavia	(Keane, 2017; Kempe, 2016; Mizrahi, n.d.)
D	Caucasus	(Pipan, 2016; Shin, 2016)

Table 34. Overview of found land registry cases

All these cases officially announced projects to store and transfer records of land ownership via blockchain – some projects are already piloted and being tested (A and C), other states already announced to join (e.g. Dubai). Land registry and transfer of ownership, historically, are perceived as bureaucratic and costly, involving an authorized third party, e.g. notary services and state bodies, to seal those transactions and to maintain the records for generations to come. The bookkeeping often relies on paper-based documentation, which promises longevity and reliability. It comes as no surprise that mostly, but not only, developing countries put a special emphasis on this matter. Land tenure is indeed seen as basic for further economic development, including financializing through collaterals. Assets as lands are both valuable and necessary, thereby lucrative for fraud or corruption. Fraudulent renting, expropriations, extortion, and bribery are as well documented as corruption in dealing with governmental or notary third parties (Bandeira et al., 2010; Shin, 2016; Victoria Louise Lemieux, 2016).

In the case of A, a country in West Africa, the blockchain project is part of an overall state digitization initiative which aims at creating a novel eco-system, connecting notaries, state, investors, and citizens. Land records ambiguity and corruption have motivated this initiative. Their implementation partner is active in more than five countries and maintains more than one thousand land records at the time of writing. This blockchain-based solution is quite original: it authenticates transactions with proof-of-stake, which is faster and cheaper than Bitcoin's mining-intensive proof-of-work. It also links its own tokens to both permissioned and permissionless blockchains to leverage their different properties. In practice, to ensure the system's resilience against tampering, each token is linked to Bitcoin blockchain, whose scale guaranties proof-of-existence, and a storage chain, where to save actual records data. Responsible for data entry is a partnership between state authorities and notaries, who can also modify claimed contentious data and thereby acts as a single 'point of truth'. The authentication of records therefore partly relies both on open infrastructures and local actors (both state and private).

Case B targets a prototype in a Caribbean country which can be considered as first-mover in blockchain-based land registry. Consistently with the idea that blockchains may have positive effects where other modes of governance encountered problems, this country has gone through decades of failed land reforms. The World Bank has been active here for decades and this project can be seen a recent development of a long-term international presence. The implementation partner is US-based and applies his offering to various domains beyond land registries, which means that, differently from case A, the solution is less tailored onto the specific application and the social context of use. Same as in case A, record ambiguity and officials' corruption were the main driver for this initiative. Starting with a proof-of-concept in 2015, the project has been stalled shortly after its announcements due to political issues (reelection) and is currently regaining pace. Similarly, to case A, the state of B remains the 'single point of truth' regarding data entry but it may have easier access to modification of records because all nodes of the permissioned blockchain used, run, at the time of writing, on servers belonging to a single organization. Originally, this blockchain relies on proof-of-burn, which facilitates the control on frequent changes of the records, also traced on Bitcoin blockchain.

The project regarding case C in Scandinavia started in 2016 and includes the state land registry office, a consultancy, a telecommunications provider, a blockchain-based implementation partner, and financial institutions. Long term national efforts for the digitization of state services have been the main motivation for undertaking land registry and facilitate digital and secure ownership transfers. At the time of writing, the project finished its second test run. From a technical perspective, data entry and changes are decided upon by the state authority in a permissioned blockchain which is embedded in the existing spatial data infrastructure, also comprising the cadaster. The authenticity of records is thereby solely dependent on the state and its infrastructure, in contrast to case A and B, and does therefore not rely on record maintenance provided by independent miners like Bitcoin blockchain's. The goal to make information available to affiliated, authenticated parties is eased by the utilization of electronic ID's provided by the telecommunication provider, and apparently in conformity to EU regulations.

The state of D, whose territory and sovereignty have been under threat, is known for its e-government efforts especially in collaboration with international agencies. It partnered up in 2016 with a US-based implementation partner in order to increase land record reliability. This implementation shows similar traits as case A and B, relying on a permissioned blockchain which is anchored to the Bitcoin blockchain using distributed digital timestamping. This might be particularly important in case of occupation. Still, the state, again, remains responsible for these foundational data entry, while the Bitcoin's proof-of-work assures data integrity.

9.5 A Proposal for Tribal Governance

The domains of blockchains applications that we considered (money transfer, intellectual property rights management, supply chain monitoring), and the specific illustration provided above from land registries, show some basic differences between blockchain governance and the bazaar idealtype (also refer to the idealtypes in table 33):

- Contrary to open source licenses that prevent anyone to appropriate the “matter of trade” (i.e. the developed software), public ledgers introduce authentication into digital settings. So we move from ‘carrots and rainbows’ (Krogh et al., 2012) to rivalry;
- While in FOSS projects the majority cannot enforce its decisions onto everyone, because anyone can fork their own version relying on publicly available code at low cost while preserving their own use value, in blockchain matters majority decisions are enforced and forking poses substantial costs on all users;
- Cryptocurrencies or other built-in blockchain rewarding schemes affect people’s involvement not least because they trade and hoard tokens. This is not a feature of other FOSS projects;
- Derived from the previous points, blockchains manifest a level of mutually dependent interest, thus organizational togetherness, that the bazaar idealtype does not accounts for.

The blockchain architecture thereby marks a paradigm shift in two ways: a) from traditional and centralized to digital and (currently) decentralized authentication method, and also b) from a digital gift economy to online-only trades. This is new because before it, one could only rely on credit money or do things for free, trusting in a gift economy. A third option, i.e. both digital native and paid directly, is allowed by distributed authentication of transactions, which introduces rivalry in the digital environment. In other words, authentication allows an alternative to the gift economy without having to rely on external guarantors.

While we maintain that digital modes of governance present substantial differences from previous ones, we find the common emphasis on software reductive. The focus on FOSS as main empirical reference for the bazaar governance idealtype is limiting because it overemphasizes the production and development of software over its deployments and actual usages in practice. Because of their functioning as long term immutable ledgers, blockchains cannot be designed, deployed, maintained, nor understood without considering their actual use and the tensions they generate in real-life settings. Those phenomena manifest only at scale and when real interests are involved.

Lustig and Nardi (2015) pose special attention onto algorithms as defining aspect of Bitcoin, whereas we argue that ledger’s maintainers and tokens’ users are what characterize the governance of blockchain as much as the other governance purposes it can be used for. Indeed, beyond software development, the authenticity of the ledger is what maintainers guarantee and users rely upon. Authenticity is not a straight product of algorithms, but a sustained long-term effort that all involved parties contribute to and depend upon. Beyond software developers, miners (or whoever maintains the ledger) and traders (or whoever uses the tokens for the most diverse purposes) gained a prominent role in governance. These peculiarities (authentication vs. infinite replicability, actual use at scale, long time frame) prompted us to propose 'tribal governance' a new mode of governance and outline its cornerstones.

The broader and distributed performance that tribal governance relies upon is not accounted for by the bazaar idealtype and its sole focus on production, copyleft and transaction cost. More precisely, the digitalization of authentication functions usually performed by organizations reveals some limitations of the bazaar idealtype:

Rivalry originates a sense of togetherness which FOSS does not have because exiting/forking is far less damaging (at the same time this is not a network because identities are not fixed and membership is volatile);

- Its low control intensity does not apply because, even if it remains true that blockchain software can be easily modified as any other FOSS, those changes are not relevant for authentication until they substitute the current software version run by miners and users;
- Thus, copyleft may affects but does not define blockchain-related issues and their capacity to mobilize human and technical resources, and also commit them over long periods of time;
- Rather than as always under development product, blockchains are better conceptualized as a means of governance for what they authenticate and how.

These peculiar characteristics of blockchain governance, which diverges from the bazaar but does not fall back into Powell's threefold categorization substantiate our proposal for the 'tribal governance' idealtype. Reasons for referring to tribes are: they use to have their own mode of governance which is not defined by the rule of law; despite own rule, they use to interact with societies regulated by formal laws, whose territories they often cross; they have charismatic chiefs but the boundaries between inside and outside the tribe are often vague (Bodley, 2011).

Tribal governance can be well illustrated by land registries. Swan (2015), as much as our interviewees, are aware that deploying blockchains as reliable records for decades-long periods is not only a matter for software whose code is freely accessible in the future. In fact, providing the required time longevity of records is about ensuring from the beginning the persistence of a functioning consensus mechanism (including hashing power, stakes, etc. depending on the blockchain type). Needless to say, compromised records would be catastrophic for national land and real estate records, with so much of the economy anchored to them. In sum, trust needs to be built far beyond software itself and its code availability. In the cases of blockchains for land registries, faceless trust needs to relate to identifiable properties. Usually, notaries and state officers are in charge of it. This raises up the questions of liability: if there is no unique responsibility, who is liable when something goes wrong. The awareness of those risks manifests in the cases above, whose blockchains are both linked to Bitcoin's -by far the most reliable blockchain because its size and track record- and state records. However, this also induces conflicts between modes of governance: trust in the crowd (or better in the 'tribe') may not align with trust in the state ('hierarchy'). If in 20 years an immutable blockchain records a different owner for a piece of land than an old paper certificate, what would a judge trust?

Descending from this sort of problems, it catches the attention that bureaucracies -certainly a manifestation of hierarchical governance- are traditionally in charge of authentication. This raises the interesting question of how their functioning encounters and collides with blockchain tribal governance, which promises to perform the same function but relies on a possibly incompatible governance mode. Some of the aspects of this encounter emerge from the Estonian project of providing identity authentication also to non-Estonians, later relying on blockchain (Sullivan & Burger, 2017). The Estonian e-residency initiative (Sullivan & Burger, 2017) raises concerns regarding identity authentication and the possible consequences of displacing responsibilities. This is in line with the call for individual accountability (Ghassan O. Karame, 2015; Raiborn, 2015). Our initial empirical work showed that the interactions between existing authorities and blockchain records are far from settled. For instance, there is no full scale and routinized land registration relying on blockchains. Rather, specific disputes are recorded on pilot blockchains in case they can help court cases. This is particularly interesting in countries based on the common law.

Comparing bureaucracy and blockchain-based authentication. Here one can see remarkable differences, especially important appear to be those about relying on private resources for providing a service of general interest (see Morabito (2017)). It is certainly a concrete risk that, if in the future public and private interests diverged, there would be no mandate nor legal basis to force a faceless crowd of actors to act in the public interest. Since blockchain users, like skillful internet users more generally, may operate with some level of anonymity across jurisdictions, bureaucracies are in short of fit-for-purpose tools. Here the famous internet motto "We reject: kings, presidents and voting. We believe in: rough consensus and running code" points to a mode of governance of an open-ended aggregate of actors –rather than of a defined citizenry – through consensus.

Long term consequences in practice remain unpredictable, especially where state authorities may not be taken for granted. In prospect, reliable records promise to exclude unreliable authorities, thus reallocating elsewhere some traditional functions of hierarchies, markets and networks.

10 PAPER IX: Hanseatic Governance: Understanding Blockchains as Organizational Technology

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Abstract

Blockchain technology provides a distributed ledger and is based on a logic of peer to peer authentication. It gained prominence with the rise of cryptocurrencies but provides a much broader field of possible applications. While it has been originally closely linked to a libertarian agenda rejecting organizations, its developments have illustrated that this ideological framing is being reversed in practice. Based on contrastive empirical cases, the purpose of our paper is to discuss blockchain as an organizational technology. Its peculiar mode of governance, which we name 'Hanseatic', needs to mediate between the fluidity typical of Free and Open Source Software development and the immutability that use organizations adopt blockchain for.

10.1 Introduction

Money does not have backup copies, thus its governance is different from data's. The failure in understanding this basic difference in its far-reaching consequences has led key players in the cryptocurrencies and blockchain spaces to assume that the well-tested and very effective mode of governance that define Free and Open Source Software (FOSS) would have been enough to manage blockchains successfully. The main problem this article addresses is that FOSS, and related theorizations, have focused on software *design* and production[110], whereas blockchains are defined by authentication, which depends on and is shaped by *use* contexts. Thus, through contrastive cases, it is argued that the governance of blockchains needs a peculiar arrangement, which we named 'Hanseatic' after the coalition of cities that formed the League which defined Northern European economics and politics before modern states substituted alliances with the Rule of Law.

Over recent years Bitcoin – the largest blockchain to date – has gone through never-ending conflicts so harsh in modes and tone that FOSS never saw. Disinformation campaigns, silencing or defamation of opponents, and overloads of the network to make it unusable led to multiple gridlock situations, thus repeated 'forks' (i.e. independent and incompatible spin-offs) of this blockchain. Another illustration of the shortcomings of rejecting explicit organizational governance, often derogatorily equated to 'central authority', is the failure of the Decentralized Autonomous Organization (The DAO) and its assumption that governance functions can be reduced to contracts, instantiated then automated via smart contracts. Overall, those cases illustrate the limitations of the explanatory power of the Bazaar metaphor, which Raymond (1999a) put forward to characterize FOSS governance.[111] To frame the far-reaching theoretical ramifications of these empirical problems, we need to take a step back.

Online, all data used to be the same, there is no inherent difference between original and copy. Since reproduction and distribution of data have nearly zero marginal cost, scarcity of data has become a non-issue in recent decades. In other words, the non-exclusivity (one's use does not exclude everyone else's) of information goods like a novel or a song has become more difficult to restrict by regulating their supports (paper books or music CDs). This is a root cause of both major transformations of industries, starting with music, and novel

[110] At best, FOSS is agnostic about software use. For example, its 'freedom 0' recites "The freedom to run the program as you wish, for any purpose" (https://www.gnu.org/philosophy/free-sw.en.html)

[111] It is noteworthy that, even if it is well established, the Bazaar metaphor (reminiscent of trades and haggling) is probably not the most appropriate to characterize FOSS.

organizational forms like FOSS and Wikipedia.[112] The inherent difficulty of containing data replication and distribution made information technologies effective in minimizing transaction cost (Demil and Lecocq 2006), but also ill-suited to provide money, which must be non-counterfeitable – thus inherently exclusive – without a 'central authority' acting as guarantor. In a nutshell, blockchains substitute 'external' organizations with technical immutability, thus dependability, of a ledger authenticated by its so-called miners.[113] Despite these design intentions, our final claim is that blockchains are suitably conceptualized as organizational technologies, whose apt mode of governance is 'Hanseatic'.

The blockchain bypasses non-scarcity of data and brings exclusivity of data via native authentication into the digital environment (Miscione et al. 2018). The novelty introduced by blockchain is the distributed mode of ledger's authentication vis-á-vis certifying organizations (i.e., 'central authorities') with own mechanisms of accreditation and auditing. Bitcoin proved the viability of digital scarcity by making all transactions public, clustering them in 'blocks', each sealed by 51% of the available computing power.[114] This means that a blockchain is simply an ever-expanding collection of timestamped blocks of transactions whose integrity is authenticated by a combination of technical and governance designs. Those ledgers locate each and every item and differentiate it from any other at any point in time. In practice, it makes no sense to copy items out of the ledger that authenticates their validity. It would be like handwriting '100 Euros' on a piece of paper hoping to buy something with it. Reversely, if a piece of data (like a novel for instance) retains its validity outside its blockchain, relying on a blockchain is pointless, if not impractical, in the first place.

Blockchain originated from the need that any currency has to avoid counterfeiting and has been subsequently applied to new domains like transaction records (of financial exchanges or supply chains, for example) or registries (vehicle records and cadasters, among others). This means that cryptocurrencies are authenticated tokens, which can be used by whomever accepts them, thus money's fungibility. The deployment of blockchains to specific domains like used cars and land registries (which we present below) requires to adjust to the specificities of each use context, which cuts fungibility (clearly, one cannot trade a car for a parcel directly even if their records were on the same blockchain, say Ethereum, which also

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112 This text does not rely on differences between data and information. The main dichotomy here is data/information vs. tokens, i.e. blockchain-authenticated records.

113 Authentication is here intended in its basic meaning of certification of genuinity, i.e. non-tempered with. *Per se*, the immutability of distributed ledgers does not guarantee data quality, even if transparency and traceability may deter from poor data entry.

114 For space limitation, this article keeps the description of blockchain technologies to the minimum. Exhaustive reference books are Antonopoulos (2014) and DuPont (2019), or Drescher (2017).

runs a currency). Despite its origins rooted in the avoidance of organizations, seen as limiting the freedom of individuals, we argue that blockchain is developing as an organizational technology, i.e. defined by the entanglement between blockchain governance and use context. In fact, in order to certify authenticity without a formal organization as guarantor, all participants need to organize: they have to cooperate to keep the system as a whole running reliably in order to handle a finite number of authenticated records ('tokens' from now on[115]). In short, the capacity of authentication, defined by consensus algorithms and sealed continuously by miners, is relevant for governance purposes because it ties together software developers (or system designers, more broadly), miners (or whoever maintain the ledger), and users. No one of them can easily break away from the others without losing much more than they would by forking a FOSS project: developers without miners would see their tokens carrying no authenticity, thus value, and users would not follow suit. We chose records of used cars and land registries because they clearly illustrate these points.

After highlighting the constitutive organizational aspects of blockchains, this paper continues to identify the features of the mode of blockchain-related Hanseatic governance, which mediates between FOSS's fluidity and blockchains' immutability. Narrowing it down to an exploratory research question, our focus is on: How does blockchain governance differ from the governance of Free and Open Source Software (FOSS), often referred to as 'bazaar'? At this point it is important to note that in this paper we are focusing on designers and maintainers because their mutual dependency marks the major difference from FOSS.

The rest of the paper is organized according to the following argument line: like FOSS, blockchains spread beyond and outside of formal organizations but, unlike FOSS, use contexts constrain designers' freedom because of authenticity and immutability, without which there would be no reason for using a blockchain in the first place. So, blockchains differ from FOSS governance (data governance differs from tokens') because developers cannot do without partnerships with authenticators. These passages are first defined in their theorical relevance, then illustrated through contrastive empirical cases: The Decentralized Autonomous Organization's (The DAO from now on) governance problems demonstrate the failures of reducing governance to algorithms. Then, systems for second-hand car market and land registries show the role of consortia in mediating across diverse use organizations. Based on those cases, our conceptual answer to the research question is the metaphor of the Hanseatic League: an alternative, consortium-based governance model for organizational technologies.

[115] Throughout this text, we use 'token' to refer to the items handled on both permissionless and permissioned blockchains.

10.2 Literature and Framework

Over the decades, governance has been defined in many ways. Williamson (1975) explains it as the explicit or implicit contractual framework within which a transaction is located, it pervades with order relations where potential conflict risks to hinder mutual gains. Even if transaction cost played a central role in influential studies on governance, it remains too narrowly focused on to economic explanations for our purposes. Beck et al. (2018) emphasize decision-making by understanding governance as the means for organizational and economic coordination utilizing decision rights, incentives, and accountabilities. According to Ziolkowski et al. (2019), governance describes how responsibilities and powers are aligned among actors, who decides, how the decision-making process is conducted, and how decision-makers are held accountable. In order to accommodate the diversity of use domains that blockchains are and can be applied to, here we consider relevant for governance as the ability to get actors to behave as they would not (adapted from Stoker (1998)). This relational definition of governance covers formal and informal power, thus different modes of organizing like markets, networks, hierarchies, or bazaar, and accounts also for powerful forces like prices, agreements, social norms, contingencies, hype, charisma, etc. which all proved explanatory in blockchain cases. Since design and practice often differ substantially (Ciborra 2000), we searched for literature about blockchain, organization, and governance with a specific interest for blockchains in actual use, rather than for publications outlining the potentials of this emerging technology, e.g. Tapscott and Tapscott (2017) and Davidson et al. (2016), who place emphasis on reduction of transaction cost. Not least because of the long-time cycle of implementing IT, studying them, and going through peer-review processes, we could not find many academic studies of actually implemented blockchains used in real-life settings. So, this section starts with a few cornerstone studies from the emerging studies on blockchain, then it defines our broader framework starting with FOSS governance.

Seebacher and Schüritz (2017) reviewed the literature on blockchain technology highlighting how it can enable services. Walsh et al. (2016) conducted a literature review to gain an overview of blockchain characteristics, a necessary step to define blockchain types: Decentralized/Extensible (Bitcoin), Decentralized/Inextensible (Counterparty), Centralized/Extensible (Ripple), and Centralized/Inextensible (R3). Beck et al. (2018) rely on the more established dichotomies permissioned/permissionless and public/private. The following table positions those dichotomies as general affordances for blockchain governance.

	Access to Transaction Validation

		Permissionless	Permissioned
Access to Transactions	Public	All nodes can read, submit, and validate transactions	All nodes can read and submit transactions. Only authorized nodes can validate transactions
	Private	(Encrypted records can be pegged to permissionless blockchains for proof-of-existence)	Only authorized nodes can read, submit, and validate transactions

Table 35. Classification on Blockchain Types, modeled after Beck et al. (2018), based on Peters and Panayi (2015)

Beyond classifications like by Swan (2015), Morabito (2017) still offers the most exhaustive overview of the state-of-the-art of blockchains in organizations, especially in finance, supply chain management, health care. In all of them, the consensus mechanism is the centerpiece as it assures the integrity of the ledger and discriminates the validity of proposed transactions. These coordination mechanisms define how validators participate in the blockchain functioning. Scholz and Stein (2018) foreground the organizational aspect of blockchain and aim at showing specific novelties in comparison to other types of organizations. Digital immutability through native authentication, thus the possibility of governance through blockchains, is reflected in collaborative ventures to explore the benefits of blockchain technology both for profit and non-for-profit (Gratzke et al. 2017).

While permissioned blockchains can preserve some permissionless blockchain's characteristics such as decentralization, immutability, and auditability, they present a wider variety of features for identifying users, assigning transaction, validation, and access rights. Ledger maintenance here is rarely guaranteed by proof-of-work but by other, more efficient consensus algorithms like proof-of-stake or Byzantine fault tolerance among others (Zheng et al. 2017).

Given the lack of cases with a substantive role of end users, here we limit our focus on the governance 'of' blockchains. So, while we remain aware of the peculiarities of each domain of application and its end users, we do not expand in those directions here. Our theoretical framework is presented in two steps. First, the bazaar mode of governance – typical of FOSS – is introduced, then its explanatory limitations for blockchain are highlighted. Second, recent studies that help our theorization are discussed.

10.3 Organizing in the Open: the Bazaar

There are two related reasons why FOSS and its peculiar mode of governance is relevant when studying distributed ledgers of different sorts: blockchains software is more often than not released under FOSS licenses, and second, influential blockchain developers come from that environment, thus adopt and promulgate the same formal and informal rules, which emerged and consolidated on the open internet. The openness that the internet allowed has questioned and eroded the centrality of formal organizations in organizing societies, and originated numerous and sometimes influential concepts like the 'open innovation' (Chesbrough, 2003), 'wisdom of the crowds' (Surowiecki 2005), 'the wealth of networks' (Benkler, 2006), and 'generativity' (Zittrain 2006). Regarding the peculiar mode of online organizing, Raymond (1999) first, and Demil and Lecocq (2006) later, labelled it 'bazaar' and relied on FOSS as the main illustration.[116] According to them, rather than formal hierarchical organizations – referred to as 'cathedrals' – online organizing resembles a bazaar, where individuals move in and out easily and organize on the basis of merit and reputation. David D. Clark, an early internet architect, captured this mode of governance with a slogan that became famous: "We reject: kings, presidents, and voting. We believe in: rough consensus and running code." Remarkable successes of this mode of organizing, also referred to as 'commons-based peer production' (Benkler, 2006), governed FOSS (Coleman, 2013) and Wikipedia (Aaltonen & Lanzara, 2015; Jemielniak, 2014).

The bazaar mode of governance emphasizes the non-appropriability of digital data, which originated as part of early software developers' practices of tinkering with code, subsequently became protected by open licenses. The effect is the obliteration of property rights, thus the impossibility of trading software. In the 90s these ideas and practices of free sharing of software were against all the received wisdom of product management, and the business model of software multinationals like Microsoft. Detractors claimed that without economic incentives to trade software, and hierarchies to manage its development, FOSS would fail. Instead, it thrived with an organizing mode that Raymond (1999), who developed Fetchmail (a FOSS email client), likened to a 'bazaar' as opposed to the 'cathedral' of software corporations.

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[116] Regarding terminology, this article uses 'form of organization' and 'mode of governance' interchangeably. This is not only due to the literature of reference, which oscillates between the two terms (Demil and Lecocq 2006; Powell 1990), but also to our broad understanding of organizing, which underpins both. Following Czarniawska (2014), we understand organizing as a process that is broader than organizations, which are a relatively structured and stable way of organizing.

FOSS took a hegemonic position over the internet not only by ignoring much of the received wisdom about IT governance (Raymond, 1999), but also projecting the possibilities of open collaboration far beyond software development. For instance, Wikipedia has shown that peer production can be governed in such a way that it yields products superior to those produced by formal organizations like publishers (Jemielniak 2014). The FOSS literature has explored different aspects of this mode of organizing. Main foci have been: motivation and incentive – typically based on voluntary work and reputational benefits (Feller & Fitzgerald, 2001), emphasis on the creativity that commons licenses allow (Benkler, 2006), protection of the commons against overuse and vandalism (Benkler, 2006). Notwithstanding its initial motives, over the years FOSS had to acknowledge that other forms of hierarchy emerged over time (Jemielniak, 2014; Shaikh & Henfridsson, 2017). Something similar is happening to blockchains, although via a different path.

Following the more nuanced theorization of the bazaar by Demil and Lecocq (2006), developers build up their reputation, which in turn they can spend providing assistance on the software they know. So, the bazaar operates at an aggregated low level of control on actors' behaviors, not least because – having full access to source code – anyone can always fork their software and develop it in their own way. Since FOSS licenses are viral, forking reinforces the commons by spreading it rather than diminishing it. So, FOSS generates limited polarization of public vs. private compared to the long-lasting debate around the tragedy of the commons (Bollier & Helfrich, 2014). The bazaar proved really effective and efficient in mobilizing dispersed resources. Nonetheless, its advantages become available only under specific conditions, not all met by blockchains. The issue is that the bazaar misses to account for the authentication that blockchain-related governance is characterized by (Miscione et al. 2018).

Bitcoin first, and other blockchains in subsequent years, have originated from the same bazaar mode of governance, which relies on public software repositories and globally distributed technical skills, privacy concerned actors, rejection of corporations and states (DuPont 2019) (Zheng et al. 2017). However, blockchains operate and develop differently from FOSS, especially because of the role of miners who maintain the blockchain by authenticating transactions in a way that also end users find satisfactory enough to trust the system. Their roles diminish software developers' freedom of taking the technology where they like. For these reasons, the bazaar does not explain the governance of blockchains. Since the ultimate test for an organizational technology lays in use organizations (which comprise authenticators and the variety of end users involved), and use organizations are constitutive of blockchains by authenticating the ledger they rely upon, then, emphasizing software design – like FOSS theorizations use to do – is misleading.

Bitcoin was the first blockchain that tested at scale a rewarding mechanism for keeping faceless and globally dispersed actors complying with its rules of authentication (Miscione et al. 2018). Differently from the abundance that operators in a bazaar take for granted, blockchain re-introduces scarcity and opens a prospect for a different governance. Blockchains are peculiar and interesting for governance because they promise to scale easily when they reach a critical mass, but they are difficult to manage because of lack of both formal organizational structures and clear boundaries to police (Ziolkowski et al. 2019).

In sum, blockchains originate from FOSS, but have profound differences. Bazaar governance is an open-ended organizational mode of software developers volunteering to code while remaining under low control and incentive pressures, thus building their skills and reputation. In contrast, blockchains as a matter of ex ante design, restrict the availability of tokens, enforce incentives, thus exercise a significant amount of control on all parties involved. In sum, tokens are governed differently from information goods and related bazaar governance (Raymond 1999; Demil and Lecocq 2006) because they embed organizational functions like consensus and authentication which define a remarkable level of mutual dependency among the parties involved. This main difference is made evident by forks, which delegitimize the authenticity of a distributed ledger, thus undermine the value of its tokens. Last but not least, tokens are not free because each has a production cost and transaction costs (its own's and of what it may stand for). Those differences motivate the need for formalizing our proposal for Hanseatic governance. To get there, this paper continues by first presenting contrastive case studies on the base of which our theorization is discussed later.

10.4 Authentication: open like the Internet and tight like Money

Against the background of the openness that the bazaar guarantees and depends upon, the major innovation introduced by blockchain – and proved viable at global scale by Bitcoin – is distributed authentication to avoid both double-spending and reliance on external guarantors. As a result, both blockchains' strengths and weaknesses depend on being, at the same time, open like the internet and tight like money. This anomalous combination of properties is certainly new and worth attention. Blockchains have been widely portrayed as trustless, which is usually interpreted as: blockchains are algorithmically governed, thus do not require interpersonal or institutional trust (Beck et al. 2016). However, they do require trust that the system has been properly designed and runs flawlessly, which also implies trust in the designers of the blockchain and in its maintainers. The DAO case exemplifies how this trust – like any trust – is precarious and may be unwarranted.

Lustig and Nardi (2015) investigate how Bitcoin's algorithm has gained authority and legitimation in allowing new trades. In this sense, algorithms are discussed as a way of directing human activities by defining what to rely upon. They criticize the emic views of people promoting Bitcoin for their naive assumptions about technological neutrality and independence from allegedly corrupted politics. A similar approach can be seen in the discussion on blockchain-based state governance (Atzori 2015; MacDonald et al. 2016). Even if we agree that algorithms are not neutral in transforming human behaviors, organizations, and societies, we find that a narrow focus on algorithms does not account for novel aspects that blockchains bring to the fore when compared to the bazaar: authentication is guaranteed by miners and legitimized by users. These actors pass unseen by a narrow focus on algorithms. In practice, if we consider only algorithms, we would not see much difference between blockchain software code and blockchains in use, which depends on the authentication needs of specific domains. Distinctly from information technologies, the constitutive role of use organizations along software developers makes blockchain a relevant instance of organizational technologies because they automatize consensus and authentication within distinctive contexts of use, which are typical organizational functions.

Authentication is here intended in its basic meaning of certification of genuinity, i.e. each of the limited number of tokens in existence can be traced back to an owner at any point in time. This means that, although most blockchain software is open source (so it falls under the bazaar governance mode), tokens' authenticity (thus blockchains' value) depends on those who authenticate and use the ledger. The centrality of consensus maintenance sets blockchain design, development, and deployment apart from technologies that only compute and transmit information while leaving consensus and authentication to organizations. In short, governance cannot be conceived as an add-on topic but needs to be considered as constitutive of blockchain and its application domain.

This digital native way of authenticating tokens constitutes a qualitative shift from the abundance that defines the bazaar. Tokens moderate software design freedom to grant authenticity. For their users, this novel balance between openness and tightness allows for new arrangements. Nevertheless, Agre (2003) argues, we should not be deterministic about how technological architectures interplay with institutional arrangements. Use will tell how those interplays develop.

10.5 Methodological Notes

A useful analytical distinction is governance 'of' vs. 'by' blockchain. With the notable (but difficult to investigate) exception of illegal trades, blockchains have yet to prove the promised disruptions in organizations, sectors, industries, etc. So, the focus of our empirical work cannot be but on the governance 'of' blockchains. Governance 'by' blockchain, in which end users have a heavier weight, will be possible when more use cases will have run their courses. Because of space limitation, and since we have described our research methodologies in other publications, we refer to them (Kavanagh et al., 2019; Miscione et al., 2018; Ziolkowski et al., 2018, 2019) for all details about those case studies.

When approaching any global information system like blockchains, especially Bitcoin and Ethereum (on which The DAO was based), methodological challenges arise. First, we considered Latour's suggestion to 'follow the actors'. As in many comparable cases, the main identifiable actors are the software developers. Focusing on them only would have been problematic because it would have implied an overemphasis on software design over use, which would overlook significant shortcomings of the explanatory power of the bazaar for blockchains. Second, other relevant actors might not be organized as visible communities with distinct values, venues of communication, and practices. So, Latour's recommendation presented substantial limitations not least because online actors using global blockchains can be millions, and key non-developer actors tend not to be easily identifiable nor visible. Then, we considered Czarniawska's recommendation to 'follow the actions'. This had the undoubted advantage of being agnostic about actors, but still did not solve the problem of sheer scale of the empirical domain. Thus, avoiding studying the more technical community simply because it was easier to identify and follow, left us with no specific actors to follow, and no specific actions to look at in the worldwide conglomerate of actions and transactions that define blockchains. The solution to this impasse presented itself.

In spite of the difficulties derived from the lack of clear boundaries defining who is who and what happens where (i.e. identifying and studying relevant actors, actions and places) it was clear from the fora and specialized press we had been following, that those involved in blockchains (especially permissionless) shared a sense of what constituted problems. Following Hoppe (2011), this situation suggested us to 'follow the problems' as they manifested and were dealt with. The general publicity of online organizing made the objective of following problems, and how they were dealt with by a multitude of actions, feasible.

Our focus on consortium-based blockchains is the result of long-term engagement in interorganizational systems. The two cases presented below are a large design science research project dedicated to improving the used car market, and an interview-based and documentary study of land registries. The consortium developing and deploying a distributed ledger for the second-hand car market was studied through participant observation in the frame of design research. While all authors are well-aware of the progress of this research project, two authors have prominent roles in it and have been documenting it extensively. Land registries have been investigated first through wide-ranging documentary analyses of online materials and gray literature provided by actors directly involved. Then, semi-structured interviews with key actors were conducted and when possible repeated over an extended period of time, so to grasp a sense of the evolution of those projects.

10.6 Illustrations of Governance 'of' Blockchains

The empirical section comprises three empirical cases: the first presents the exemplar governance crisis that affected The DAO, and the blockchain underneath it: Ethereum (the second largest after Bitcoin). Its rupture made its deeper functioning and risks visible. The following part presents two consortia-based blockchains, one for secondhand cars in Switzerland, the other for the land registry in Georgia. They present a viable alternative to the shortcomings of assuming the possibility of automatizing governance. All these case studies focus on organizational and governance issues and provide empirical evidence that blockchain is not conforming to the FOSS governance models. The DAO is representative of the governance shortcomings that permissionless blockchains manifested over the last decade. Thus, it is used as a theoretically informed steppingstone to introduce the crucial role consortia play in accommodating use organizations in the domains of secondhand car market and land registries. Those empirical findings are later discussed in the light of the metaphor to the Hanseatic League.

10.6.1 Loss of Innocence: no 'Complete Contracts'

The DAO was a social experiment in organizational governance. Its goal was to bring forth a decentralized and innovative business model, which would allow investors to transparently, democratically and fairly fund collectively voted projects using the raised cryptocurrency capital. Built upon Ethereum's smart contract feature, The DAO was the first of its kind. This spirit of openness and decentralization helped The DAO to gain traction quickly.[117] This visionary platform launched on April 30th, 2016. On May 28th, it raised approx. 14% of Ethereum's total currency supply and was the largest initial coin offering (ICO) by then. One bug in the code went unnoticed and was exploited on June 17th to drain about a third of the enclosed funds. However, a failsafe method allowed a voting period of 28 days before transactions are committed to the ledger. This timeframe allowed developers, users, and miners time to decide what measures to put in place. However, it quickly became apparent that this issue was out of The DAO's control. Its smart contracts had been executed accordingly to its design and credited to the idea of decentralization and 'code is law' principles, the contract contained no inbuilt measures to break ledger's immutability to expropriate the attacker. As a matter of facts, the attacker complied with the smart contract's rules and thereby, some argued, obtained the funds technically correct, thus legally. As a result, The DAO's incident could only be solved on the underlying layer, i.e. Ethereum blockchain. The project's prominence henceforth put financial, media, and legal pressure on Ethereum's community to make an appearance and decide on the event's handling.

Following this exploit, a group of The DAO's and Ethereum's lead developers and community members teamed up quickly and convinced major exchanges to halt the native Ethereum's token trading, which was the currency of the stolen capital. Simultaneously, white-hat counter attacks drained and secured the remaining funds, which by the community was perceived as taking the 'role of fiduciary to The DAO and its members'. Having averted further and imminent threats, the loathed politics that cyber-libertarians aimed at eradicating with decentralized blockchains retook front and center stage. Despite the confusion arising from not having roles for who is in charge of what, the options boiled down to either ignoring and accepting the exploit, or introducing changes to Ethereum's protocol, i.e., forking. Two opposing factions emerged in this debate, one called for an amendment, i.e. a hard-fork, and one that opposed any interference. Supporters of the latter persuasion argued that 'transactions are immutable and code is law'.[118] Unlike in a bazaar setting, a hack of the ledger to reverse the exploit would contradict both core beliefs and purpose of decentralized authentication. Members of this sentiment considered any intervention a 'centralized bailout [of a] decentralized protocol'[119] and described The DAO as being 'too big to fail'[120]. By contrast,

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[117] https://blog.slock.it/the-history-of-the-dao-and-lessons-learned-d06740f8cfa5
[118] https://www.reddit.com/r/ethereum/comments/4unpm3/the_dao_and_the_benefactors/
[119] https://www.reddit.com/r/ethtrader/comments/4oif5c/fck_this_dao/
[120] https://www.reddit.com/r/ethereum/comments/4oithy/a_too_big_to_fail_political_hard_fork_is_very/

forking advocates regarded the proposed amendment to depict 'business as usual'[121], claiming[122] that fixing bugs within protocols has always been part of software development processes. By arguing so, the latter framed the interpretation according to the bazaar mode of production and away from the authenticity and immutability aspect that blockchains are rooted in.

Ultimately, miners, not developers, decided on the outcome by committing their hash power to the favored chain. The faction opposing the fork eventually turned out to be in the minority and blamed, among others, Ethereum's founder, Vitalik Buterin, for exerting his political clout in favor of breaching technical immutability through human intervention. The presence of Ethereum's 'benevolent autocrat' became well visible in this situation, distinguishing it from Bitcoin and its anonymous founder who withdrew completely and appeared no more during debates to voice his well-respected opinion, letting factions flying the flag of his writings. One user voiced his view on the situation by concluding 'chancellor Vitalik on brink of first bailout for DAOs'.[123] Some miners and users refused to acknowledge the new protocol and continued to apply the original ruleset. This inevitably caused the fork and induced a chain-split, dividing the project into two distinct blockchains. While the original blockchain is since referred to as 'Ethereum Classic', the current Ethereum main chain is actually the forked one, not the original. Following this precedent and its evident consensus-making complications, one user aptly wondered 'if there will ever be a consent on proposals with that many shareholders'.[124]

Altogether, a single project's failure became a broader community's concern, forcing it into internal disputes and re-interpreting its core values: as no compromise solution was available, any decision would either lead to infringing Ethereum's immutability and thereby betraying decentralization's and its fundamental values, or losing valuation and the user's assets. One part regarded the outcome a 'legitimate community response'[125], the other saw the tyranny of the majority in the voted solution the '[ending] of what Ethereum was always meant to be'[126]. However, most of the fork opposers ultimately applied the new ruleset, understanding

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[121] https://www.reddit.com/r/ethereum/comments/4op69x/no_hard_fork_does_not_mean_dao_holders_lose_all/
[122] https://www.parity.io/attack-on-the-dao-what-will-be-your-response/
[123] https://btc.com/86f03176beef99ac2f5adecd39b964f874f5ec615a9d01e88ac781c6e669753c_It is worth noting here that cryptocurrency advocates matured a deep resentment for bailouts and quantitative easing policies by 'central authorities'.
[124] https://www.reddit.com/r/ethereum/comments/4ihkld/the_dao_must_diversify/
[125] https://www.parity.io/attack-on-the-dao-what-will-be-your-response/
[126] https://www.reddit.com/r/ethereum/comments/4oj7ql/personal_statement_regarding_the_fork/

Ethereum to be a ‘democracy, not technocracy’[127] in which ‘all that matters is consensus’[128], even if executed algorithmically.

For the sake of the present argument, The DAO case illustrates three points:

- contracts are not and cannot be complete – thus their assimilation to software code, which always contains bugs, is hazardous – and always depend on the wider context they operate in,
- there is – by definition – no response to unforeseen shortcomings of the code, which exposes the risks and the required trust into the system, its designers and its maintainers,
- if immutability is only alleged, derived claims of substituting governance with blockchains become questionable.

The other cases and the following discussion discard the dichotomy governance vs. blockchain, and argue that blockchains are indeed organizational technologies with a peculiar mode of governance through consortia that retain some of the powers that permissionless blockchains tried to delegate completely to technology. These consortia-based blockchains aim at avoiding governance problems exemplified by The DAO by creating an – albeit imperfect – governance structure with case-specific tailoring of access and authentication rights, allocation of responsibilities, reliance on existing jurisdictions and institutional contexts (Ziolkowski et al. 2019).

10.6.2 Tackling Information Asymmetry in the Second-hand Car Market

This case illustrates a consortium-based blockchain to deal with the used car market, where good and bad cars are not easy to distinguish, thus: a) parties with better information are more likely to strike better deals, and b) worse cars drive better ones out of the market as mentioned by Akerlof (1970). The ability to make a good assessment of a car’s value relates to the completeness and reliability of information about it. However, obtaining relevant car information can be a daunting endeavor. In other terms, information asymmetry is inherent to the used-car market. This project’s developers were early on interested in how far a distributed ledger may reduce information asymmetry between buyers and sellers, thus

[127] https://www.reddit.com/r/Futurology/comments/2bypb7/does_an_automated_society_still_need_humanrun/

[128] https://www.reddit.com/r/Bitcoin/comments/2fch11/would_you_argue_that_bitcoin_has_more_or_less/

reducing the negative influence of 'lemons' onto the used car market. Consequently, they adopted an information management angle rather than an economic one. In other words: a complete record of information combined with traceability and authenticity of information, which blockchain provides natively, may reduce the current asymmetry of information.

During the lifetime of a car, numerous actors (insurances, repair shops, state agencies, and many more) are involved. This leaves all information about a car fragmented at best, or even exposed to opportunistic behaviors. In practice, it became apparent that creating a more consistent and reliable record of cars (AutoFile from now on) requires the coordinated effort of many actors. Therefore, the developers proposed a blockchain-based platform, which would act as a boundary object mediating across stakeholders to overcome the shortcomings of a market for lemons.[129]

The AutoFile is run by a consortium of major stakeholders in the Swiss automotive market: The AutoFile consortium comprises organizations at all points of the value chain, as well as competitors: The main importer and repair shop of cars, a major insurance company, a road traffic authority, a car rental provider. The actual development was driven by a software company, researchers, and legal experts. One major challenge has been the coordination of interests and governance mechanisms. When the development reached a maturity where a launch of the platform was foreseeable, the consortium founded a non-profit association to provide a point of reference for governance of the shared platform. This effort was also motivated by the need (1) to onboard the critical mass of users the platform rests upon, and (2) the ability to prototype business processes in a real-life setting, (3) to provide a meeting place where also the state agencies could participate. The last point has a particular governance relevance: while a good used-car market is of public interest (which lemons' sellers skew), it is difficult if not impossible to manage the AutoFile as a public good. Therefore, an association offers the chance for a public-private partnership to negotiate both public and private interests through the design and deployment of novel services.

This consortium agreed on an association's statute comprising core rules such as membership rights and obligations, the association's purpose, fee structures, and thereby serves as a playbook for a novel ledger before it is finalized and sealed as immutable by authenticators. If conflicts emerge in the future, standard societal and legal modes of conflict resolution would apply. One may object that this choice limits innovation potential, but participants decided to build on the existing institutional context, which is conceived as an enabler rather than an

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[129] It is worth noting that there are two problems about those records: their completeness and their integrity. A blockchain can address only the second.

obstacle to innovation. For instance, a cantonal traffic authority joined to instill credibility into the project since its inception.

The entanglement between blockchain governance and institutional context is particularly evident in relation to the legal framework regulating privacy, which emerged as a defining issue early in the process. Personal and car-related data cannot be distinguished easily from each other. While the sharing of the latter is generally harmless, the former is quite sensitive, and heavily regulated, especially by the GDPR. Since drawing the line between the two is all but straightforward, the system had to be designed to compartmentalize different kinds of data and keeping each tied to their legally bound organization. Because of this, a first proof-of-concept built on Hyperledger had to be abandoned. In fact, distributing all data across all participating nodes, even if encrypted, proved not fit for the project's purposes. If all data is shared across all nodes, the association would have no mean to terminate local data usage because every participant would manage a full node independently.[130] Therefore, the AutoFile consortium moved in the opposite direction of delegating as much as possible to technology. It adopted a distributed ledger because of its higher flexibility and governance discretionality it leaves to the association.

Privacy issues can be seen as exemplar of how distributed authentication interplays with data ownership, usually marginally considered in bazaar settings, and multiple lines of responsibility. Regarding the latter, even if the association comprises multiple organizations, there is not a hierarchical level above them. Each organization upholds responsibility on the data it brings to the ledger. For instance, an insurance company may share (part of) their clients' data (like about accidents) on the shared ledger, but it remains responsible for them in front of its clients and legal authorities. Issues like this illustrate the organizational complications that such consortia have to deal with, and the risks of delegating as much as possible to automated governance before having used the blockchain in a real-life setting. The other blockchain governance issue is the mutual dependency between developers and maintainers. Since it is clear to all parties that forking would undermine the validity of the ledger, association members are required partnership fees to join. This is because having 'skin in the game' reduces the risks of opportunistic behaviors later on.

[130] Incidentally, similar kind of concerns about potential uses are affecting the Libra consortium and its negotiations with regulators, who expressed their concerns about how to comply with KYC (know your customers) and AML (anti-money laundry) duties in a cross-jurisdictional setting.

10.6.3 Certifying Land Ownership beyond Jurisdictions

Even if the AutoFile sees the participation of a public traffic authority to the consortium, state organizations are not as central as in other sectors like urban and regional planning, and land management more precisely. The land registry domain is a promising use case for blockchain as noted at the World Economic Forum (Hutt, 2016). Blockchain-based land registries come with the promise of overcoming several of the challenges of this complex and multi-stakeholder inter-organizational setting (landowners, brokers, notaries, banks, and state agencies) with far-reaching ramifications in all parts of economy and society. The processes of authenticating land ownership and transfer vary vastly between jurisdictions, but several commonalities are observed: they can be considered slow, sparsely digitized, often opaque, costly, and embedded into very low trust environments. Because of its high valuations at stake, not least for its use as collateral, land registration is heavily exposed to fraudulent behaviors which have been particularly problematic in developing countries (Benbunan-Fich & Castellanos, 2018; De', 2005).

Immutability of blockchain records have a particular significance in places prone to corruption, fraud, natural catastrophes, political instability, or, in extreme cases, invasions. Fraudulent renting, expropriations, extortion, and bribery in dealing with governmental or notary third parties are not uncommon (Ziolkowski et al. 2018). This is not to say that blockchains would overcome all these challenges, but they might ease these problems and increase the reliability of records by offering a tamper-resistant, decentralized database[131]. We have been surveying projects and consortia dedicated to blockchain-based land registries in many countries, including Sweden, Estonia, Honduras, Ghana. Here we focus on Georgia for the peculiarities of this case.

"The economist Hernando de Soto told us that only one third of all people can prove they own their land. Apart from the legal uncertainty, there is $20 trillion in dead capital, as land with unexplained legal titles cannot be sold. So, we told him, 'Find us such a country and we bring the land register to the Blockchain for free. And that was Georgia"[132] stated a member of this consortium. Associated actors, such as banks, notaries, and Georgia's National Agency of Public Registry (NAPR) are loosely coupled and cannot trace processes amongst each other,

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[131] Reese, F. 2017. "Land Registry: A Big Blockchain Use Case Explored," CoinDesk, , April 19. (https://www.coindesk.com/blockchain-land-registry-solution-seeking-problem, accessed November 26, 2018)

[132] https://medium.com/bitcoinblase/blockchain-application-land-register-georgia-and-sweden-leading-e7fa9800170c

mistakes occur, and they are costly to correct, also for citizens. Furthermore, all NAPR servers are centralized. Hence data can relatively easily be tampered with or even destroyed, for example in the extreme case of an invasion, which is less remotely possible than for other countries: the last war with Russia dates merely ten years back; less than four years ago, Russia annexed Crimea, which is only across the Black Sea from Georgia. NAPR employees have mentioned all of these as motivation in their effort to build a blockchain-based land registry which is also pegged onto the Bitcoin blockchain, thus beyond the reach of any occupying force.[133]

While in developed economies efficiency is often a selling factor for blockchains, in Georgia security concerns score far more prominently. In fact, immutability and extra-jurisdictional reach of blockchains is seen a potential succor against a threatening neighbor. The risk NAPR is trying to avoid is not only that occupying forces destroy ownership records and appropriate land. It is not unthinkable that records can be wiped out through a cyberattack, which has become a common concern in former Soviet countries like Ukraine.[134] This is an illustrative example of how governance of blockchain (editing access to land records, for example) exceeds a national legal framework and addresses broader concerns through a mix of cryptographic authentication run by Bitcoin miners without any specific interest for this countries, but whose activities are beyond the reach of a state power. Leaving aside those extreme circumstances, pegging land records to the Bitcoin blockchain in the form of a hash at specified points in time through a digital time-stamping service[135] offers a proof-of-existence and serves as a checkpoint to prevent also smaller scale fraudulent tampering of past transactions.

Another central issue, which too often is conflated with immutability, is how to certify data quality before it gets on an immutable ledger. In Georgia, the NAPR is responsible for data entry to the system, which requires trust in its reliability (Ziolkowski et al. 2018). However, NAPR foresees an important measure to increase transparency: it is allowing other parties (banks, notaries, NGOs, and later also citizens) to read the ledger, which contains all historical data, and thereby to control the well-functioning of the system.

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[133] The system is called 'Exonum', an explanation how it specifically works can be found here: https://exonum.com/napr

[134] Also documented here: https://www.newamerica.org/future-property-rights/blog/blockchain-for-property-rights-georgia/ and https://www.reuters.com/article/us-estonia-cybersecurity/with-an-eye-on-russia-estonia-seeks-security-in-computing-cloud-idUSKBN0TN1BT20151204

[135] Shin, L. 2016. "Republic of Georgia To Pilot Land Titling On Blockchain With Economist Hernando De Soto, BitFury," Forbes, April 21. (http://www.forbes.com/sites/laurashin/2016/04/21/republic-of-georgia-to-pilot-land-titling-on-blockchain-with-economist-hernando-de-soto-bitfury/, accessed May 18, 2017).

10.7 Hanseatic Governance

Our research question was: ‘How does blockchain governance differ from the governance of Free and Open Source Software (FOSS), often referred to as ‘bazaar’?’ The internet opened up for a very effective mode of governance which relies upon non-scarcity of data: the bazaar, of which FOSS and Wikipedia successes are glaring examples. The bazaar mode of governance relies upon licenses that protect the nearly zero marginal cost of reproduction and distribution of data. Against this background, our research problem has been that the bazaar does not explain essential peculiarities of blockchain governance. More precisely, blockchain originated from the need of avoiding ‘double-spending’, i.e. duplication of data, without putting any formal organization in charge of authentication. Blockchains escape main tenets of the bazaar mode of governance because maintainers remain in charge of authentication. Thus, designers are tied to them to certify and extend the value of the blockchain. In other words, the bazaar’s emphasis on software production overlooks use and the inter-organizational mutual dependency of all parties. Guaranteeing the immutability of all records on a ledger generates a much tighter path dependency than in the bazaar. Software developers may be free to fork the code, but it is of little use in practice if parties cannot trust records about used cars or land parcels, following the examples above. Therefore, we argue that maintainers and users of tokens characterize the governance issues of blockchains. Authenticity is not a straight product of algorithms but a sustained long-term effort that all involved parties contribute to and depend upon. Beyond software developers, miners (or whoever maintains the ledger), generators of reliable records, and uses have to be included in any governance model. More precisely:

1. While in the bazaar the majority cannot enforce its decisions onto everyone, because anyone can fork their own version relying on publicly available code at low cost while preserving their own use value, in blockchain matters majority decisions are enforced, and forking poses substantial problems to both developers and maintainers;
2. Contrary to open source licenses that prevent anyone from appropriating the software code, public ledgers introduce authentication thus scarcity into digital settings. Traceability of all (trans)actions on the ledger act as a deterrent from breaking the rules. So, blockchain move from ‘carrots and rainbows’ as main incentives (von Krogh et al. 2012), to a ‘gentle rivalry’ within a consortium like the AutoFile (Ziolkowski et al. 2019);
3. The uncertainty about tomorrow puts more pressure on what is done today because forking later on would be troublesome. Consortium-based projects do not assume the

possibility of future-proof complete contracts but rely on existing legal arrangements according to which all partners are tied together by mutual dependency.

Throughout this paper, we have emphasized how the peculiarities of using blockchains are in mutual dependency with their design. Our proposition is that this is a peculiar governance model, which is going to interplay with a variety of application domains. Before characterizing it as Hanseatic governance, we use a table to contrast and compare blockchain governance characteristics with FOSS and proprietary software.

All examples in Table 36 deal with goods that need varying degrees and modes of protection for different reasons. Counterfeiting is a key issue for proprietary software and the blockchains examples. Uncontrolled access is an issue when property of information goods (proprietary software) or privacy of people (financial assets) are a concern. For cars and parcels, certification of records is paramount, controlling access may be a matter of policy (who has the right to access and for what) or a commercial issue (monetizing information access). The three blockchain examples deal with very diverse institutional pressures. What connects them is the defining role of immutability and authenticity, which originates mutual dependency among the parties involved. The consequences of these peculiar arrangements are about balancing cooperation and competition while avoiding forking, and thus undermining blockchain authenticity. Those same problems and rationales manifested also in The DAO example, and its underneath blockchain Ethereum. They shape any blockchain that promises unique tokens standing for something else (AutoFiles, land registries, health records, goods tracking, etc.), data quality (accuracy of the ledger), unique relation between an object and its record, liability.

		Proprietary Software	FOSS	Bitcoin/The DAO	AutoFile	Land registry
Scarcity and protection of the matter of trade	Product protection	Legal: Transnational enforceable copyright Technical: DRM copy protection, license management	Legal: Licensing agreement for reuse (GNU, CC)	No legal protection Technical: Cryptographic consensus mechanisms to authenticate transaction. Forking as option of last resort	Existing national and international legal framework, especially GDPR Technical: cryptographic consensus mechanisms to authenticate transactions	Existing national legal framework Technical: Cryptographic consensus mechanisms to authenticate registry entry (and updates)
	Production input	Hierarchy with paid software developers	Bazaar of volunteer developers, reviewers, quality managers	Bazaar of volunteer developers, reviewers, quality managers Miners who get rewarded with the tokens they authenticate	All parties join up in a consortium that agrees with designers of the organizational set-up Developers and maintainers are part of the consortium	Digitization of existing records Pegging them to an extra-jurisdictional blockchain Planned: introduction of smart contracts
	Revenue model	Licenses to users and hardware vendors	Primary: None Secondary: Value added services	Transaction fees Hoarding	Partnership fees Planned: information access charge	Possible cost recovery models: taxes and/or fees

Organizing aspects	**Means of regulation**	Software platform monetized through license fees & sales	Peer produced software protected by copyleft licenses	Peer produced tokens	Consortium agreeing on what to make immutable, thus delegate to maintainers, and what to keep discretionary	Consortium built around the state land registration authority
	Path dependency	Investments of software industry and users	Collaborative practices for versioning, compatibility	Immutability ➔ Versioning via majority consensus or forking	Immutability ➔ Versioning via association deliberations	Immutability ➔ Versioning via consortium deliberations (state veto power)
	Overall governance	Hierarchy (ownership)	Community, meritocracy of production, agnostic about use	Minimal, derived from FOSS, rules, roles and incentives defined ex ante	Defined by use organizations in association. Records sealed by blockchain	Defined by use organizations lead by NAPR. Records sealed by blockchain
	Conflict resolution	Hierarchy	Community, forking	Majority rules	Car Dossier association (statutes) Existing legal frameworks	Existing legal frameworks Extra-jurisdictional blockchain as last resort

Table 36. Characteristics of exemplar cases against governance dimensions

Blockchain consortia are defined by people, organizations, and their environments more than endogenous incentive schemes on permissionless blockchains. The – loathed by crypto-libertarians – politics of creating alliances are central to define consortia's discretionary powers, which, coupled with the reliance on the existing institutional context, allow them to cope with the inevitable unpredictability of future situations. Thus, we name this mode of governance 'Hanseatic' after the Hanseatic League of the 13th to 16th century, after the fragmentation of feudalism and before the consolidation of modern nation-states in Europe, whose Rule of Law's subsequent rise to powers marked the League's decline. With the Hanseatic League, trade guilds across many cities spanning from nowadays Holland to the Baltic countries formed alliances that proved hegemonic in Northern Europe trade through the North and the Baltic Seas. The Hanseatic League's favor for orderly trade over conflicts resulted in a protracted period of prosperity and peace. It is suitable to underline that this alliance leveraged resemblances and common interests between member cities while marking their difference from the rest, but without undermining their independence.

The Hanseatic League used to have its own mode of governance, which was heavily relying on trust rather than defined by an overall constitutional framework like the Rule of Law of modern states. Another reason to adopt this metaphor is the role of the guilds, professional associations that influenced the League's decisions, similarly to expert organizations having a more prominent role in consortium-based blockchains (in the AutoFile: university, software company, traffic authority, lawyers, etc.). The Hanseatic League also provided aids for safe navigation (including lighthouses and safe harbors), and defended its members from the constant threats of pirates. For reasons of space, the following table illustrates how aspects of the Hanseatic League correspond to blockchain governance by relying on the AutoFile case, only.

	Hanseatic League	AutoFile
Share-holders	Coalition of German towns and merchant communities (horizontal alliance [or more loosely coalition] to compete successfully with other alliances or individual actors)	Coalition of stakeholders interested to build secondhand car records and at the same time avoid any kind of monopoly
Objective	Protecting mutual trading interests: Trade facilitation, mutual protection, trade monopoly in a region (not of any member over the others)	Interested in higher transparency in the used car market and committed towards basic governance principles: public service for Switzerland, non-monopolistic access charge. Second phase: data markets
Mode of operation	• Reciprocity, economies and politics of scale • “inside maneuver: extending competence/ resource base” • “outside maneuver: extending control over the environment” • Risk sharing • Mechanisms of (self-)protection	Joint (collective) production and governance of car lifecycle information infrastructure
Pitfalls	Obstacles to trade: • Logistics, reciprocal exchanges – economic challenges • taxation, customs, levies – legal, but costly (financially and process-wise) • piracy – illegal, requires protection (“libertarian” logic: we have to rely on ourselves).	Risk of monopolization or fragmentation of “market” for used car information. Need to ensure: • information quality, • certification/ authentication of information (or relevant access token), • Protection against unintended exploitation of the infrastructure.

Shared assets technology	"The four Kontore at London, Brugge, Bergen, and Novgorod were communities that enjoyed exemption from the jurisdiction of the land in which they were established, administering their own (German) law and subject to the directives of the Hanseatic diet." Encyclopedia Britannica Design of a boat type (Baltic cog).	Agreement on technical standard (blockchain/ crypto algorithms) and common (production and access) infrastructure.

Table 37. Matching of aspects of the Hanseatic League and our main blockchain case, the AutoFile

The resonance between the Hanseatic League and a blockchain motivates to propose the peculiarities of Hanseatic governance as different from the bazaar, defined by resource abundance and organizational fluidity. It is noteworthy that we do not claim that this mode of governance is an ideal type like hierarchy, market, or network ('confederation' might be). Rather, we define it as a lens to look at governance of blockchains. Following from Table 37, we characterize Hanseatic governance as follows:

1. Creating a framework for collaboration based on an agreed set of goals and incentives.
2. Setting-up an institutional and technical infrastructure (including traceability and reliability of the records) exceeding specific organizational domains or jurisdictions to increase effectiveness of operations and joint protection against perpetrators,
3. partial[136] delegation of typical organizational functions like consensus and authentication to technology (Hanseatic trade was made safer by specific boats and lighthouses, for example),
4. need to anticipate and negotiate early in the consortium the known, and possibly unknown, scenarios ahead of the initiative (similarly, Hanseatic allies had to organize for the long journeys of their cogs), and agree on what automatize and what keep discretionary.

[136] This partiality is indirectly corroborated by the fact that no other technology is so closely tied to jurisdictions, especially small and agile ones like Switzerland, Malta, Liechtenstein, Gibraltar.

10.8 Blockchains as Organizational Technologies

In terms of theoretical contributions, this work claims, on one side, that existing governance conceptualizations do not explain distinctive characteristics of blockchain, and that Hanseatic governance has a better explanatory power. On the other side, that blockchains can be seen as an instance of 'organizational technologies', by which we mean technologies whose core function is not transmitting information, but perform functions – inevitably entangled in and sensitive to an institutional context – that use to pertain to organizations, like consensus and authentication.

Despite their accomplishments, blockchains showed the limitations of rejecting explicit, and more sophisticated, modes of governance. Glaring failures have been efforts to change the Bitcoin block size and The DAO. The empirical issue with theoretical relevance is that the openness of the bazaar, which enacts a mode of software production, clashed with the immutability of those ledgers and their dependence on use organizations. These mismatching logics are evident in cases of forking: from a bazaar perspective it is a manifestation of freedom, if not simply 'business as usual', whereas for blockchains forks undermine uniqueness and immutability of tokens. Thus, blockchain mode of governance is distinctive, and we likened it to the Hanseatic League for the prominence given to mutual dependability within an alliance and the extraordinary organizational achievement to build a trade network and indeed infrastructure, which lasted well over 200 years. Application domains like second-hand car market and land registries showed how this technology is providing organizational functions that redefine organizational behaviors.

Authentication used not to be a function of FOSS projects, nor of digital-only endeavors. The novelty of blockchains is not in how they were peer produced, which resembles most FOSS projects, but in the authentication they allow in partnership with authenticators, that remove the fluidity and open creativity of the bazaar. Benkler (2006) classified different forms of digital collaboration like crowdsourcing, online labor markets, prize competitions, peer production depending on their complexity and knowledge. According to his view, open innovation produced by firms organized in networks lies in-between highly decentralized and innovative peer production and routine and predictable crowdsourcing. In his analytical scheme, blockchain-based governance is not a point on a chart, but a governance arrangement which might facilitate the growth of 'networks of firms' both in the direction of peer production (online actors can rely on tokens to formalize their transactions) and, on the opposite direction, towards online markets and crowdsourcing to the extend immutable ledgers increase security and may reduce transaction costs.

In conclusion IT has been changing how things get organized for decades now. Peer-to-peer networks, cloud computing, social media, to name just a few waves of digital innovation, are instances of a mode of organizing which has been: a) circumventing the structures and conventions of formal organizations, and b) changing and disrupting markets while opening new ones. The most recent trend of digital innovation is blockchain, which embeds functions that used to be the domain of organizations: consensus and authentication. In a nutshell, the contribution of this paper is that Hanseatic Governance accounts for the necessary mediation between the openness of the bazaar and the immutability of distributed ledgers. Consortia retain some powers to reach consensus when inflexible, preset algorithms cannot. Long-term consequences in governance remain largely to be studied in practice, especially where other forms of authority cannot be taken for granted. In prospect, reliable records embedded in an organizational infrastructure are promising in low trust environments, like where states or other authorities are weak. The modes of those encounters would offer promising research avenues.

11 PAPER X: Exploring Decentralized Autonomous Organizations: Towards Shared Interests and 'Code is Constitution'

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Abstract

In recent years, scholarly interest research on blockchain technology steadily increased. While the underlying technology matures, observed problems in the field show questions of governance to remain crucial, even though scarcely studied empirically. One approach of solving these problems can be seen in decentralized autonomous organizations, which describes a new type of organizing that is grounded on consensus-based, distributed autonomy. The governance peculiarities of DAOs is fairly unexplored, and this is where this research commences. In an exploratory multiple case study consisting of three popular DAOs Aragon, Tezos, and DFINITY, their governance peculiarities are worked out by analyzing grey literature to understand stakeholder interests, incentivization, control, and coordination mechanisms, technical considerations, and external influences from off-chain entities. In the context of an on-and-off-chain continuum, it appears that DAOs provide mechanisms that might enable autonomous decision-making but, at the same time, find themselves strongly influenced by the interests of various stakeholders.

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discussing Tezos, Aragon, and DFINITY; parts of their empirical descriptions stem from Raffael's work; all errors are our own. Our research team does not hold any tokens/assets associated to the herein described projects.

11.1 Introduction

Blockchains like Bitcoin and Ethereum have shown their capacity to scale globally while retaining their capacity of avoiding double-spending. However, the maintenance of uniqueness of a finite number of tokens at a global scale comes at high costs. While those costs are often identified with the environmental impact of hashing, a more subtle issue is worth attention: the immutability of the ledger created fractures within the communities underpinning each blockchain. To understand reasons and modes of those fractures, this study digs into the technicalities and governance problems that a new wave of blockchains aims at tackling.

Blockchain projects, since their early days, relied on informal ways of governance resembling features of the free and open source software (FOSS) mode of organizing (Miscione, Klein, et al., 2019). Blockchain governance, despite insiders' common beliefs, is not exhaustively defined by FOSS because of its peculiar reliance on the mutual dependence of several parties including system developers, system maintainers, and users, to say the least (Islam et al., 2019; Miscione, Klein, et al., 2019). This mismatch between belief and practice did not go unnoticed: Bitcoin and Ethereum went through and survived several troubling forks, i.e. spin-offs of independent and incompatible ledgers. In practice, each time a problem about a blockchain arose, never-ending conflicts unfolded without the possibility of a formal authority, which was despised in the first place, to accommodate the situation (DuPont, 2017). Thus, the lack of formalized rules for conflict resolution is substituted informally by charismatic leaders and heated debates, for example.

Tezos, Aragon, and DFINITY are examples of a new wave of blockchain projects, which develop decentrally-governed infrastructures to execute decentralized applications (dapps). Their governance thereby builds on principles of so-called decentralized autonomous organizations (DAOs). They try to leave the risk of 'civil wars' behind by formalizing the rules to change the rules when need arises. In short, if the first generation of blockchains formalized consensus maintenance among unknown parties, this second generation aims at formalizing the rules according by which consensus rules can be changed. Those rules are enacted by these blockchains, thus the common term of 'on-chain governance'. With an analogy that is as catchy as inaccurate, one may say that, instead of 'Code is Law' (Lessig, 1999), meaning software has a regulatory function like laws, those blockchains aim at 'Code is Constitution' to the extent that constitutions contain passages that define how powers are divided, and how regulations are agreed upon before being enforced.

Several researchers call for research on DAOs, especially in decomposing their actual structures and applied governance mechanisms (Beck et al., 2018; Rossi, Mueller-Bloch, Thatcher, Bennett, et al., 2019). This research attempts to address this research gap by carrying out an exploratory multiple case study. The cases of Bitcoin and others have shown the fragility of a shared interest between quite diverse actors. To this end, DAOs promise to do better by applying advanced governance mechanisms while minimizing human intervention; in how far these overcome the issues highlighted by previous blockchains is a research gap with important practical implications. In this study, three DAOs with overlapping goals but varying technical solutions, namely Aragon, Tezos, and DFINITY, are examined. We thereby follow a three-step process: first, we introduce each case by depicting the DAOs' organizational and technological structure and brought-forward concepts. Second, we create an understanding on how these DAOs are governed by examining their governance systems (Albers, 2019) in terms of applied/envisioned coordination, control, and incentive mechanisms. Lastly, we discuss our empirical observations against their aspired goals and associated concepts such as institutionalism (North, 1990) and generativity (Zittrain, 2006). Considering the latter, the understanding of the governance systems of these relatively specific types of organizations, and its contextualization to associated concepts help to comprehend current evolutions in blockchain governance. Narrowing it down, our focus is on:

RQ1: How are Aragon, Tezos, and DFINITY governed in terms of coordination, control, and incentivization?

RQ 2: What can we learn from Aragon, Tezos, and DFINITY in regard to blockchain governance?

This paper is organized as follows: we introduce related concepts of online governance and its links to blockchain governance in the next section, followed by a description of our methodology. Then, we introduce our cases and detail their coordination, control, and incentivization mechanisms one by one, which answers RQ1. Within the discussion section, we relate findings from our cases to the wider frame of existing literature about blockchain governance to answer RQ2. We conclude this paper by outlining limitations of our research and potential avenues for future research.

11.2 Related Work

Within this section, we first introduce related work on modes of governance. In subsequent steps, we then introduce central terminology for this paper and show the evolution of blockchain governance over time. We conclude this section with a description of the lens which we applied to analyze our DAOs.

11.2.1 Modes of Governance

Building up on new institutional economics, modes of governance are classified into markets, hierarchies (Williamson, 1975a), and networks (Powell, 1990). Markets and hierarchies relate to internalizing/externalizing activities depending on transaction costs measured in asset specificity and transaction frequency. These are seen, broadly speaking, through the lens of control (evaluation against goals), incentive (monetary/non-monetary), contracting (modality of arrangement) and coordination (division/alignment of work) mechanisms. The network extends this dichotomy with a relational view of actors with a shared goal. Within these three, actions are determined by price and free choice (markets), bureaucratic control and authority (hierarchy), or reciprocity and mutual consensus (networks). As Miscione et al. (2019) argue, which is in line with other researchers (Beck et al., 2018; Demil & Lecocq, 2006), these modes of governance are limited means to explain the online modes of governance as seen, among others, in wisdom of the crowds (Surowiecki, 2005) or generativity (Zittrain, 2006), but also on FOSS. FOSS, as an instance of commons-based peer production (Benkler, 2017), is characterized by informal ties among actors, open licenses, no central steering entity, and forks of software (Demil & Lecocq, 2006). In contrast to markets, network, and hierarchies, FOSS' open license limits rent seeking from property rights (thus undercuts market governance), relational contracting is hindered due to anonymity (network), and its "structurelessness" (Freeman, 1972) – meaning the absence of formal structures – turns bureaucratic control unfeasible (hierarchy), to say the least. Even if blockchain technology finds its origins in FOSS, the unlimited replicability renders the FOSS governance mode insufficient for blockchains as we will argue below. Furthermore, several researchers (Allen et al., 2020; Davidson et al., 2016; Meijer & Ubacht, 2018) see blockchains as new institutional technology, which compete with markets, hierarchies, and networks as more efficient ways of governance. Within this research, we define governance as the ability to get actors to behave as they would not in pursuit of an agreed-upon goal (Miscione et al. 2019).

11.2.2 Blockchain Governance: Fundamentals and Foci

This paper studies blockchain governance, so technical details are only introduced to the extent that they are relevant. Blockchain systems are herein understood as blockchain applications and their organizational embedment (Ziolkowski et al., 2020b). Broadly speaking, blockchains rely on the principles of decentralization (no central authority), persistency (transaction immutability), auditability (traceability of events), and anonymity (key pair authentication) (Zheng et al., 2017a). They can be broadly classified along two axes: access to transactions and transaction validation rights, which leads to either *public* (public transactions, everyone can validate), *permissioned* (public transactions, restricted validation), or *private* (private transactions, restricted validation) blockchains (Peters & Panayi, 2015). The most common type to date are public blockchain systems, such as Bitcoin (DuPont, 2017). Miscione et al. (2018) characterize their governance as "tribal", in which actors coordinate in loosely defined groups with shared values and interests. When interests diverge, members of a tribe branch out (forking) and create their own tribe (fork).

Several researchers see blockchain governance from the two different foci *of* and *through* (De Filippi & Mcmullen, 2018; Miscione et al., 2018) and enacted in the two different modalities of *on*- and *off-chain* (De Filippi & Mcmullen, 2018; Reijers et al., 2018) (see table 38). Off-chain governance describes decision-making procedures and rules that are not directly encoded (Reijers et al., 2018), e.g. stakeholders arrange blockchain-agnostic communication to find consensus. Reijers et al. (2018) define on-chain governance as a set of rules and processes, which are directly encoded into the blockchain system, leading to ex-ante agreed-upon decision-making procedures. Its benefit is also said to be its disadvantage (De Filippi & Mcmullen, 2018): on-chain governance rules are deterministic but fail to respond to unexpected situations. This opens a loophole for reintroducing off-chain governance, which is inherently vague and can cause centralization in a field that is pervaded by the belief of decentralization (De Filippi & Mcmullen, 2018).

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Modality</td></tr>
<tr><td>On-chain
Blockchain-inherent</td><td>Off-chain
Blockchain-agnostic</td></tr>
<tr><td rowspan="2">Focus</td><td>Governance of blockchain
Focus: Blockchain system</td><td>Blockchain-inherent components that facilitate the governance of the blockchain system.
Examples: transaction validation system, built-in incentive schemes</td><td>Blockchain-agnostic components that facilitate governance of the blockchain system.
Examples: system-centric decision-making in online communities or legal bodies</td></tr>
<tr><td>Governance through blockchain
Focus: Use-Case</td><td>Blockchain-inherent components that facilitate governance of the blockchain use-case.
Examples: governing a monetary system through a blockchain system</td><td>Blockchain-agnostic components that facilitate governance of the blockchain use-case.
Examples: use-case-centric decision-making in online communities or legal bodies</td></tr>
</table>

Table 38. Governance Foci and Modalities

11.2.3 Blockchain Governance: From FOSS and "Code is law" to "Code is Constitution"?

FOSS principles are commonly adopted in the blockchain domain (Miscione, Klein, et al., 2019), e.g., decentralization, or forking and adapting own versions of software. Differently from FOSS, however, core actors need to find agreement on how to advance blockchain systems (Ziolkowski et al., 2018). Governing blockchain as FOSS showed its limitations: Having no entity formally in charge nor procedure to appeal to, decision-making processes were often painfully complicated and ineffective, leading to crises threatening the "tribe" (De Filippi & Loveluck, 2016a). As anticipated already decades ago (Freeman, 1972), "structurelessness" does not translate into the absence of structures, which applies to both FOSS and blockchains: Zheng et al. (2017) found Bitcoin to be centralized in mining power and code development. While influential figures, usually from the software development side (e.g., Vitalik Buterin for Ethereum; Linus Torvalds with Linux), emerge, their influence in blockchains is counterbalanced by miners and users (Ziolkowski et al., 2018). Aware of these shortcomings, blockchains revived the "Code is law" mantra (Lessig, 1999), from which the case of TheDAO[137] emerged, in which smart contracts gained centrality. Smart contracts originated over two decades ago (Szabo, 1997), and, in layman's terms, represent encoded (hence, immutable) and autonomously-enforced business logic (Gatteschi et al., 2018), promising lower transaction costs through automation while substituting human with algorithmic agency (Murray et al., 2019). Automation, however, requires determinism in inputs, evaluation criteria for these inputs, and outputs. This renders smart contracts appropriate for routine but inappropriate for non-routine tasks with unknown unknowns (Gatteschi et al., 2018). This last issue is well-exemplified by the TheDAO failure, as third parties had to step in as mediators (DuPont, 2017).

The two approaches shown before, one led by limited coordination and control, the other by unstoppable automation, have shown limitations. Miscione et al. (2019) formulate two ways forward: Either, (1) blockchain communities push 'code-is-law' further ('Code is Constitution'; focus on on-chain governance), or (2) external control (e.g. foundations, consortia) has to be reintroduced. This study focuses on the former: DAOs rely on decentralized collaboration, internal control, and autonomy (De Filippi & Mcmullen, 2018). While smart contracts aim to

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[137] TheDAO: the largest crowdfunding project at its time. A bug in a smart contract caused the loss of a significant amount of its funds. The discussion on how to proceed – reverting the malfunction or living with the consequences of lost funds – caused heated debates, resulting in a fork of Ethereum's community into Ethereum Classic (DuPont, 2017).

be a DAO's backbone, human involvement is formed by off-chain governance bodies and processes; users are thereby also divided along held tokens (often bound to voting power) or expertise (Raval, 2016). This re-instantiates the relevance of trust in these systems, which have repeatedly been considered "trust-free" (Beck et al., 2016; Jarvenpaa & Teigland, 2017). As several other researchers argue (Miscione, Klein, et al., 2019), this stance may be misleading as trust in both developers – that the system is designed properly – and the maintainers – assuring the well-functioning of the systems – has to be ensured, to say the least.

11.2.4 Studying DAOs through the Lens of Coordination, Control, and Incentivization

What makes blockchain, and hence, DAO governance peculiar is a mutual dependence of actors to operate, maintain, and adjust its system (Islam et al., 2019; Miscione et al., 2018). As the previous section has shown, this mutual dependence has been governed in various forms up to date. To understand the novel approaches of governance brought forward by DAOs, we utilize a lens, which Albers (2019) labeled the governance system. As Albers argues, the purpose of the governance system – allocated between governors and governed – is to ensure that desired goals are met by utilizing the governance mechanisms of coordination, incentivization, and control upon involved actors (Albers, 2019, p. 72). Thereby, we follow Ouchi's (1979) definition of governance mechanisms, which are applied to an organization to assure its achievement of goals. We define coordination in a wider sense as the division of labor into tasks, assignment to actors or groups, and the tasks' goal-oriented, ongoing alignment to assure the completion of an activity (Mintzberg, 1979), control as the process of monitoring and measuring performance of an actor regarding a given task (adapted from Albers (2019), based on Baliga and Jaeger (1984)), and incentivization as means to alter an actor's or group's willingness to engage in specified behaviors (Albers, 2019) (see table 39 below). As we will argue in the following, each of these governance mechanisms found relevance for the blockchain domain.

As for **coordination**, several researchers studied the roles of responsibilities of actors in blockchain networks, which depend on the blockchain system type (Islam et al., 2019), and the way they align their work (DuPont, 2017; Hsieh et al., 2018). Broadly speaking, these include system designers and maintainers (token-owners), who have to achieve consensus on the transactional (validation/integrity of transactions), technology development (maintaining/altering the system), and organizational (meta-rules/governing stakeholders) layer (adapted from Hsieh et al. (2018)). As for the modality of coordination, Mintzberg (1993) defined the three coordination mechanisms of mutual adjustment, standardization (of skills, work processes, or outputs), and direct supervision. Different from firms (contracts and authority) or networks (relational contracts and reciprocity), but similar to FOSS, actors coordinate and align work in blockchains often informally via repositories or online communities, which proved inefficient for blockchains (De Filippi & Loveluck, 2016a). As depicted above, smart contracts emerged as a coordination mechanism as they standardize work processes, which TheDAO exemplified with the process of funds coordination. To reveal explicit structures of these DAOs, also in regard to the actual degree of their decentralization which is bound to power (Rossi, Mueller-Bloch, Thatcher, Bennett, et al., 2019), it is necessary to decompose core actors, their tasks, and points of alignment.

As for **control**, blockchains employ various control mechanisms to assure that undertaken actions comply with mutually agreed goals. While control on the transactional layer is inscribed in blockchain protocols, control mechanisms on the technology development or organizational layer can be considered rather informal: On the technology development layer, as seen in Bitcoin, so-called Bitcoin Improvement Proposals serve as a checkpoint for review by experienced developers for quality and fit (De Filippi & Loveluck, 2016a). It is important to note, that the presence of values is strongly reflected in these, which is well-exemplified in the controversy around Bitcoin's block-size[138]. To exercise control and, for example, deal with unforeseen events, to act as a supervising entity, but also to create a common point of reference, several larger blockchain projects like Bitcoin or Ethereum founded off-chain governance bodies (associations/foundations). This is in line with calls for enacting accountability (hence, control) in general technically – via smart contracts –, but for unforeseen cases, institutionally (Beck et al., 2018). Hsieh et al. (2018), on a similar line, also see limits in the applications of DAOs when DAOs exceed the realm of FOSS, as control structures then have to protect mutual interests, which is evident in the rising number of blockchain consortia (Gratzke et al., 2017). Similarly, Meijer and Ubacht (2018) see blockchains as multi-agent systems, to which Hsieh et al. (2018) agree, and they study tensions among control and trust in these.

As actors of a blockchain systems are mutually dependent, means to foster certain behavior of actors emerges as a crucial component. The blockchain domain already knows various types

[138] Simplified: allowing for a higher transaction throughput, which would Bitcoin make suitable for payments; mining would become more expensive for node holders with a comparably low hash rate, which would foster centralization (De Filippi & Loveluck, 2016a).

of these **incentive** mechanisms, such as monetary ones for system maintenance (mining fees) or user engagement (airdrops/participation rewards), but also non-monetary mechanisms such as reputation for software contributions, as well as praise, status, or wider recognition within one's community. In presence of values led by decentralization, also the meaningfulness of one's job and, consequently, altruism are important facets of incentivization. Consequently, Beck et al. (2018) see incentivization as the backbone of blockchain systems to deal with the actors' behaviors and, hence, their mutual interests.

Drawn from the previous arguments, modes of governance in blockchain systems differ from common modes of governance due to their mutual dependence. It remains unexplored, how coordination, control, or incentivization mechanisms are utilized in DAOs, especially regarding foci or modalities (table 38), which are strongly bound to distribution of power. This demands exploration in the field.

Mechanism Category	Governance Mechanism and included concepts	Relevance for Blockchain Systems
Coordination Division of labor into tasks, assignment to actors or groups, and the tasks' goal-oriented, ongoing alignment to assure the completion of an activity (Mintzberg, 1979)	Based on Mintzberg (1979, 1993) **Mutual Adjustment:** negotiation/bargaining, liaison devices **Direct supervision:** authority/fiat **Standardization of** ... ... **work processs:** rules and regulations, standard operating procedures ... **outputs:** planning and control ... **skills:** training, indoctrination (culture)	Blockchains are organizationally and technically decentralized; how is work divided and aligned? (Rossi, Mueller-Bloch, Thatcher, Bennett, et al., 2019) Similar to FOSS, blockchains coordinate informally through repositories/online communities, which proved inefficient (De Filippi & Loveluck, 2016a) Smart contracts emerge as coordination mechanisms as they standardize work processes (e.g., TheDAO in terms of fund coordination)
Control Process of monitoring and measuring performance of an actor regarding a given task (adapted from Albers (2019), based on Baliga and Jaeger (1984))	Based on outcome measurability (OM) and task programmability (TP) (taken from Albers (2019); based on Eisenhardt 1985): high OM, high TP: **formal behavior or outcome control** high OM, low TP: **formal outcome control** low OM, high TP: **formal behavior control** low OM, low TP: **informal behavior or outcome control**	On transactional layer inscribed into blockchain protocol; on technology development layer, improvement proposals are points of control for stakeholders (De Filippi & Loveluck, 2016a). Values strongly influence against what is measured (see Bitcoin-Scaling-debate) Off-chain control is increasingly institutionalized in the form of associations, which also introduces (partly) accountability Beck et al. (2018)
Incentivization Means to alter an actor's or group's willingness to engage in specified behaviors (Albers, 2019)	**Nature of incentive:** material vs. immaterial **Basis of provision:** subjective vs. objective **Reference unit:** group vs. individual	Blockchain systems are at least dependent developers, maintainers, and third parties (users, wallet providers etc.); incentivization crucial to deal with actors' mutual interests (Beck et al., 2018). Several monetary incentivization (mining fees / airdrops/ participation rewards) but also non-monetary rewards (reputation/praise) are crucial in blockchain systems.

Table 39. Governance Mechanisms, adapted from Albers (2019)

11.3 Methodology

This research is embedded in a multi-year and multi-researcher study to explore blockchain governance, with this paper focusing on DAOs. To understand their peculiar governance configurations against the theoretical background shown above, an exploratory multiple case study covering three exemplary major DAOs, namely Aragon, Tezos, and DFINITY, was initiated. These were chosen for their size and relatively long life span, which we expected would correlate with maturity and use. Secondly, albeit they share the common trait of deploying forms of on-chain governance, they functionally differ in scope and architecture. This allowed us to study on-chain governance in different contexts. Our overall methodology follows the approach proposed by Kuckartz (2013), which we synthesize as follows: (1) collection of data, (2) codebook development, (3) data analysis, and (4) results evaluation. We detail these steps in the following.

Collection of data. Tezos, DFINITY, and Aragon gained a lot of attention from the mainstream media and, consequently, there is a plethora of grey literature but almost no academic references. Hence, the cases' publicly available whitepapers, reports, and newspaper articles were central to our empirical study. To retrieve data about these cases, the starting point was each project's official website, its individual sections, and linked documents. While the former have been our primary source for information, we also included specialized press such as Bloomberg, Forbes, Coindesk, and Medium; the latter has frequently been used by spokespeople of these projects as a channel to announce news on, e.g., the state of their development, changes in their roadmaps, or educational purposes. We utilized these statements, among others, as credible inputs to carve out the state of the art of their development and its drifts from its targets in their project descriptions. The choice to rely on a variety of sources close to these projects was important to ensure a credible depiction of these cases. Overall, our data collection has been conducted from spring to fall 2019 and comprises 116 documents.

Codebook Development. In developing an appropriate lens to study the mode of governance of DAOs, we relied on an up-to-date literature basis which informed our case study's overall design in generating an appropriate coding framework. Our coding framework, which was theoretically informed by the modes of governance introduced above in the 'related work' section, consists of 131 codes, organized on four levels of detail. Our codes center around the key categories of (1) general attributes, such as technicalities (e.g., ledger technology, protocols, stacks, consensus algorithms), organizational composition (e.g., on-/off-chain processes, internal/external stakeholders, IP-holders), and history (e.g., what has been implemented), (2) meta-codes (e.g., challenges, positive/negative effects, on-/off-chain), (3) and governance-specific codes (e.g., incentivization, coordination, control, contractual framework). To ensure the fit of our theoretical stance with our empirics, we relied in our framework development on both deductive (informed by theory) and inductive (raised by empirics) codes. Continuous improvements, additions, merging, and deletions of categories and codes were enacted throughout our research for an appropriate quality of our data analysis.

Data Analysis. To understand our cases in-depth, we applied our codebook to our data using a software for qualitative data analysis (MAXQDA) with several goals in mind. For one, for each case, thorough overviews along the dimensions of the codebook were created; as chapter 11.2 depicted that organizational processes are also ingrained on technical layers in blockchains, a sole assessment of organizational or technological aspects would have not sufficed. These overviews served as a basis to derive key insights per code category, which were gathered, and eventually compared along all three DAOs to assess similarities and differences; these were also evaluated in the next step. For two, our observed cases vary in maturity and use, and their future promises pass unseen if only their status quo is considered. Hence, we decided to examine both their status quo and their planned outcome, together. From a historical perspective, this comparison was also motivated by the search of inhibitors to becoming decentralized and autonomous. For space limitations, our result section shows only parts of the results of our data analysis.

Evaluation of Results. To not rely solely on grey literature, we initiated an internal and external sense-making process to discuss and validate our findings. As for the former, initial findings have been made available and discussed within our research group, also against observations of general developments in the DAO ecosystem. As for the latter, we decided to conduct four targeted, complementary semi-structured interviews (Myers & Newman, 2007) with DAO experts, which were transcribed for coding. These were helpful to validate our findings and to explore the evolution of blockchain governance in our three observed cases and beyond. The interviews were conducted either face-to-face or via Skype and all relied on a common interview guide. Finally, we derived general statements on governance traits appearing in all cases (validation), case-specific statements (validation), and meta-considerations for all DAOs (exploration).

11.4 Findings

In the following, each case is first introduced and second related to its governance traits in terms of coordination, control, and incentivization (see 'related work'). The latter are also divided into each projects' current state of development and planned outcome. For reasons of space limitations, the case descriptions are simplified and shortened to the extent that they are necessary for our argument. Further, we only reference central articles to the cases and sources other than the projects' or their spokesperson. A complete list of utilized sources can of course be provided upon request.

11.4.1 Overview on Aragon: Building a Self-Governed Digital Jurisdiction

Launched in 2017 after a fundraising accumulating approximately $25M[139], Aragon is an application built on the Ethereum blockchain serving as a framework for the development of other DAOs. It is led by the motif of an opt-in jurisdiction to simplify interactions between peers by facilitating functions like fundraising, voting, payments, or bylaws. While the number of DAOs built with Aragon seems impressive (539), their activity per day is found to be low to date (2-15)[140]. Aragon consists of several major parties to maintain and adjust its system: (1) its association (non-profit; oversees operation/developments, holds funds/major IP rights, employs for-profit development teams via grants, anchor to legislation), (2) Aragon Labs (non-profit; R&D entity to advance Aragon's governance), (3) the Aragon Network (actual technological network; consisting of DAOs, dapp providers, and users), and, which holds true for all observed cases and resembles FOSS, (4) free but also professional (e.g., Aragon One) software developers contributing to the project. As for Aragon's functioning[141], Aragon matches service (dapp) providers and service consumers. Aragon foresees a sustainable financing model, which compensates both dapp and Aragon as infrastructure provider: in exchange for using a service, a consumer reimburses the service provider, which then deducts a percentage of their income as a tax to the Aragon network for infrastructure provision. In return for the service providers' activity, Aragon mints (contrary to mining) and assigns them Aragon Network Tokens (ANTs), which can be used, for example, to vote on change proposals

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[139] https://icobench.com/ico/aragon

[140] https://bravenewcoin.com/insights/aragon-price-analysis-robust-dao-infrastructure-remains-waiting-for-users

[141] Retrieved March 29, 2019, from https://blog.aragon.org/introducing-the-aragon-network-20b998e2caba/

of the Aragon Network; this mechanism assures that decision-making say (number of tokens) aligns with a party's popularity. To assure smooth operations, Aragon plans two on-chain features to overcome known blockchain problems: (1) a conflict resolution system called "digital jurisdiction"[142], and (2) a coordinated way for system development and maintenance, utilizing "Aragon Governance Proposals" (AGPs) within the AGP Process[143] (AGPP).

11.4.2 Governance Traits of Aragon

Coordination. To understand, how work is formalized, divided, and aligned in Aragon, we detail its actors along the transactional, technology development, and organizational layer as defined in the 'related work'. Within the status quo, as for the transactional layer, block creation and validation are coordinated by Ethereum. Ethereum also coordinates the technology development layer, meaning alignment among validators and developers. However, users of Aragon naturally participate in decision-making within Ethereum, as an Ethereum-based token is utilized in Aragon. Consequently, on both layers, Aragon depends on Ethereum's technical choices[144]. As for the organizational layer, meaning the coordination among all stakeholders, Aragon's own association inheres a central role. This role is especially present in the direct supervision of the technical development with its two for-profit development teams Aragon One and Autark (both of which are off-chain entities). Their collaboration is formalized by, as we assume, bilateral (off-chain) contracts; Aragon's association is also the central point of coordination for independent developers and Aragon Labs. A central coordination mechanism on the organizational layer is the AGPP (currently off-chain), which utilizes tokens and stage-cycled proposal voting to obtain, evaluate, and decide upon proposals to alter or enhance the current system. Within the AGPP, the sequence

[142] Digital Jurisdiction: in case of a conflict, the plaintiff opens a case, submits supplementary information, and posts a bond (disincentive for unnecessary submissions). His case is then iteratively reviewed by random, a wider array, or top judges of the Aragon network, in case the plaintiff does not agree to proposed outcomes, while placing a higher bond each time; the final outcome is binding. Kärki & Aragon (2017), retrieved March 29, 2019, from https://blog.aragon.org/aragon-network-jurisdiction-part-1-decentralized-court-c8ab2a675e82/

[143] AGPP: (1) a submitted AGP is classified in regard to its urgency and what part of Aragon it concerns (e.g., changes to the Association). Then, the AGP proposer pursues feedback from the Aragon community. If positive, the proposer details his AGP, which is judged by Aragon users. Upon fit, the Aragon Association assesses the AGP on defined criteria and values; if rejected, the AGP is moved back to the previous stage. If approved, the AGP will be part of a reoccurring vote cycle. Lastly, the Aragon community decides upon the AGP; if approved, the AGP will be deployed for execution; if rejected, the AGP moves to the proposal stage or will be erased by its author. The AGPP as is currently in the process of being reworked: https://aragon.org/blog/evolving-aragon-network-governance

[144] Due to conflicts with Ethereum, Aragon announced its own chain: https://techcrunch.com/2020/02/19/tim-draper-puts-1m-into-the-aragon-blockchain-project-to-create-digital-courts/

of steps as well as their outputs are standardized (in terms of processes and outputs). Also, disputes of any kind are currently resolved with help of the Aragon association.

The status quo showed the entanglement of various off-chain parties and contracts to which several changes in the planned outcome are foreseen on its organizational layer. First and foremost, Aragon's long term plan is to widely dissolve its association, so that the network can coordinate itself utilizing the on-chain AGPP, which is supposed to minimize off-chain influence on on-chain decision-making. Users of Aragon will also coordinate interactions among themselves using so-called Aragon Agreements, which are directly bound to Aragon's jurisdiction (both on-chain). Both, the Aragon jurisdiction as well as Aragon Agreements constitute a standardization of work processes and outputs, which formalize previously informal processes.

Control. In the following, we examine Aragon's transactional, technology development, and organizational layer to understand, how control is exercised by whom within Aragon. On the transactional and technology development layer, Ethereum's Proof-of-Work algorithm controls the integrity of entries in the blockchain. As for the technology development and organizational layer, the Aragon Association inheres a strong controlling function. For example, the Aragon Association is involved in a later stage of the AGPP, where it evaluates – and eventually decides – upon proposed proposals, acting as a content filter. The Aragon Association thereby controls, if a proposal complies with the so-called Aragon manifesto[145] (control objective), which relies on values such as decentralization and self-sovereignty of individuals and organizations. These values are not only relevant for the AGPP, but Aragon's Association also evaluates other activities against these, such as funding for initiatives within Aragon Labs or in its task to oversee Autark's or Aragon One's development[146] – aside from the regular control of the software development process and software quality. But not only the Aragon Association actively controls: within the AGPP, in its earlier stages, proposals are reviewed by experienced users or developers to assure it to comply with Aragon's values and technological possibilities[143]. For last, the Aragon Association serves as a (off-chain) point of reference in case of disputes within and outside the network and acts thereby as a mediating entity.

The status quo shows that control, aside from the transactional layer, is mainly exercised by off-chain entities. Within the planned outcome, it is foreseen to shift control into the network

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[145] Retrieved March 29, 2019, from https://blog.aragon.org/the-aragon-manifesto-4a21212eac03/

[146] Decentralizing Aragon's development. Retrieved March 29, 2019, from https://blog.aragon.org/decentralizing-aragons-development-5062fd6d135d/

(on-chain). There are two main pillars for this endeavor: for one, the digital jurisdiction strives to encode the conflict resolution process with a sequence of steps, in which a plaintiff's proposal is iteratively reviewed against (encoded) contractual terms by experienced Aragon users; the iteratively increasing bond to be paid by the plaintiff serves as a control mechanism against unnecessary proposals. For another, it is planned to assign Aragon's assets, which are currently held by the Aragon Association, to the network; by that, the Aragon network becomes responsible for evaluation of stakeholder activities against shared beliefs or contractual terms.

Incentivization. As argued in the section 'related work', the shared interest between developers, miners, and users that blockchains bring about make incentivization prominent, and we study these in the following on the transactional, technology development, and organizational layer. As for the transactional layer, miner of Ethereum are monetarily incentivized to contribute their hashing power to the network for a token in return. Within the technology development layer, Ethereum developers have either monetary (grants within the Ethereum community) or reputational incentivization to contribute to the development of Ethereum. Within the organizational layer, members of the Aragon Network have two main incentives: (1) gathering ANTs as a speculative financial asset and (2) having the power to participate in the decision-making AGPP process to assure mutually beneficial outcomes are reached. The incentive to advance the system in a positive way is thereby interrelated with the value of its token. Even though for-profit development companies follow monetary incentivization, their well-being also depends on Aragon's.

As for the planned outcome, several changes in regard to incentivization mechanisms are planned. The transactional and technology development layer lie outside of Aragon, so these remain unchanged. As for the organizational layer, to finance the platform, a service supplier has to pay a certain fee to the Aragon Network for each transaction and receives minted ANT in return; as its revenue stream is based on volume of transactions, Aragon relies upon monetary incentivization to scale its network. Thus, a reliable and secure infrastructure for fast transaction processing is the main interest for both Aragon and service providers.

11.4.3 Overview on Tezos: Towards A Digital Commonwealth

Tezos started in 2014 and gained prominence with its record-breaking fundraise of $232m in 2017[147]. Similar to Aragon, Tezos provides a framework to create and run decentralized applications, while proclaiming itself *the last blockchain,* led by the promise of being a self-amending blockchain and offering on-chain tools to do so. While on-chain activity seems to be slowly increasing[148], we were not able to identify any live dapps, yet[149]. Unlike Aragon, Tezos implemented an own blockchain consisting of several protocols[150], which is said to facilitate change over time. Tezos utilizes the liquid Proof-of-Stake (LPoS) consensus algorithm, whose design follows the rationale that users would not hurt the system they hold equity over, where so-called bakers validate transactions[151]. A core governance process is called the amendment process, which coordinates and controls the developments of Tezos[152]. As for its organization, Dynamic Ledger Solutions (DLS) used to be a central organization founded by Arthur and Kathleen Breitman, two central figures and early contributors to Tezos. After advances of Tezos, the Breitmans founded the Tezos Foundation located in Switzerland. The Tezos Foundation impacts the network by incentivizing and selecting appropriate grantees and creating a competition between them. Tezos became famous for public feuds beginning in late 2017[153], which led to lawsuits against DLS claiming Tezos to have performed

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[147] https://www.coindesk.com/232-million-tezos-blockchain-record-setting-token-sale, accessed September 2nd, 2020

[148] https://bravenewcoin.com/insights/tezos-price-analysis-technicals-turn-neutral-despite-continued-and-sustained

[149] Overview on Tezos projects: https://tezosprojects.com/

[150] https://learn.tqtezos.com/files/whitepaper.html

[151] Tezos (LPoS) lets random stakeholders (bakers) create (bake) blocks, which is notarized by 32 other bakers. The number of XTZ (Tezos' token) held by a baker influences his chance to create the next block, block production reward and transaction fees included. As the entry barriers to become a baker are relatively high (minimum number of tokens, around 10.000 XTZ at the time of writing), Tezos allows for delegation of tokens to another party. By that, the token holders delegate not only XTZ but also trust to the baking peers and receive a partial compensation in return. Since the baker's own token deposit has to be (simplified) ~8.25% of all delegated tokens, the share of the own deposit increases with the continuous delegation of tokens, as does the incentive to bake fairly and validly. Based on: https://medium.com/tezos/liquid-proof-of-stake-aec2f7ef1da7. Retrieved April 08, 2019

[152] Four phases consisting of: the (1) Proposal Period (proposal for amendment and initial vote), (2) Exploration Vote Period (proposal discussion and vote), (3) Testing Period (proposal is implemented and tested in a sandbox), and (4) Promotion Vote Period (final vote upon implementation). Tezos thereby defines various minima for voting participation, which is weighted on past voting participation. One whole run-through lasts approximately three months. If any proposal is rejected, it is moved back to the Proposal Period. This governance approach happens directly on the blockchain. Based on: https://medium.com/tezos/liquid-proof-of-stake-aec2f7ef1da7. Retrieved April 08, 2019

[153] https://fintechnews.ch/blockchain_bitcoin/tezos-foundation-president-step-back-soon-things-track/15526/

an unregistered securities sale. As a consequence, Tezos Ltd**.** was founded to take over the management of the Tezos Foundation.

11.4.4 Governance Traits of Tezos

Coordination. To understand, how tasks are formalized, divided, and aligned in Tezos, we detail its actors along the transactional, technology development, and organizational layer in the following. Within the status quo, as for the transactional layer, Tezos' LPoS algorithm coordinates block creation and validation in accordance to the agreed-upon protocol. This task includes also the coordination of mining rewards to bakers and to non-bakers, who delegated their stake to bakers. As for the technology development layer, developers and validators, same as other stakeholders on the organizational layer, utilize the amendment process for proposals to maintain or alter the system. This is significant because it allows bakers to propose fundamental changes across layers, for example, changes to the consensus algorithm and consequently the underlying logic of coordination on the transactional layer. Similar to Aragon's AGPP, the amendment process' sequence of steps as well as their outputs are standardized (in terms of work processes and outputs). While the latter is already implemented on-chain – so proposals are formalized – also, so we assume, off-chain bilateral contracts between the Tezos Foundation and for-profit engineering teams exist. These contracts arise either by the foundation's mandate or via accepted proposals within the amendment process that cannot be easily implemented. In the case of a mandate, the foundation coordinates and supervises the engineering teams' development, which proves its central coordinating role.

The status quo has shown, that, while Tezos' main coordination mechanism is already implemented, off-chain entities and conventional contracts are still utilized. As for the planned outcome, the largest change affects its organizational layer. Similar to Aragon, Tezos strives to marginalize off-chain influences on on-chain decision-making. Unlike the Aragon Association, however, the Tezos Foundation does not seem to have strict plans with fixed milestones for its evolution. Rather, it pursues an overall strategy of decentralization, so that the amendment process would act as a central coordination mechanism.

Control. Here, we examine Tezos' transactional, technology development, and organizational layer to understand, how control is exercised by whom within Tezos. On the transactional layer, Tezos' LPoS algorithm controls the integrity of entries of its ledger. Furthermore, it is inscribed into the protocol, that a baker, to whom tokens were delegated from non-bakers, has to contribute (simplified) 8.25% of all delegated tokens in own funds as deposit. This acts as a control mechanism to bake fairly, as the own deposit and prospective mining rewards are lost in case of misbehavior. As for the technology development and organizational layer, there are two things worth noting: for one, the amendment process also inheres a strong controlling next to its coordinating function. Here, development proposals are iteratively reviewed, voted upon, and eventually tried out on a Testnet, before being considered as an amendment to the Mainnet. Users control mutually, if a proposed development works as intended, and, if it complies to Tezos' values. This control mechanism also counters possible malicious actions of whales (individuals/groups possessing a significant amount of one specific token). For another, the Tezos Foundation controls ongoing development of the development bureaus against agreed-upon goals in terms of functionality and quality and distributes grants and controls their development to interested parties in enhancing the Tezos network.

The only difference between the status quo and planned outcome is the fact that all of the above-declared external actors will be integrated into the Tezos Network, which would internalize current off-chain processes and decisions, and, by that, internalize control points.

Incentivization. To better understand the mutual dependence among the actors within Tezos, we study applied incentivization along the transactional, technology development, and organizational layer in the following; as all planned incentivization mechanisms seem already operational, we do not distinguish between status quo and planned outcome. As for the transactional layer, Baking peers are incentivized to accumulate XTZ, through own funds or delegation from non-baking peers, to higher one's chances to obtain the next mining reward. Non-baking peers have the monetary incentive to delegate their XTZ to a baking peer, as they receive a dividend in return. Consequently, more XTZ will be delegated to trustworthy bakers due to more secure earning opportunities. As a disincentive to baking peers, in the event of a misuse, the XTZ from the own deposit and collected as baking rewards are withdrawn and the baker is likely to lose the confidence of the delegators as well[151]. As for the technology development layer, at the same time, XTZ amount to decision-making say in the amendment process. So, baking peers also have the incentive to build and maintain a good reputation, as non-baking peers might shift their funds in case of disagreements. Aside from monetary incentivization, Tezos developers also strive for reputation. As for the organizational layer, the Tezos foundation monetarily incentivizes research and development of Tezos in general through grants.

11.4.5 Overview on DFINITY: Towards the (better) World Computer

DFINITY is a project, which was founded in early 2015. Against its Zeitgeist, DFINITY opted against a funding via ICO, supposedly not be associated with unregulated, possibly fraudulent projects, which were present at that time. Instead, DFINITY acquired approximately $167m[154], mainly from investors. DFINITY builds a proclaimed new generation of the internet relying on bundled, shared, and decentralized computational power. These objectives are pursued via a four-layered architecture[155]. As no Mainnet or Testnet were launched, no publicly available dapps have been created, yet. The organizational composition outside of the DFINITY Network consists of the DFINITY foundation (located in Switzerland; supervises development and maintenance; inheres funds and IPR; recruits and offers platform to developers), the DFINITY development teams, and investors. From a technical perspective, DFINITY relies on an own blockchain[156], a novel consensus algorithm, and an on-chain governance system labeled the DFINITY Blockchain Nervous System (BNS)[157]. The BNS inheres entire control over the network, for example, it can remove malicious actors from its system, put single hosted systems on hold, or dynamically change system-internal economic parameters such as its token-value. Interestingly, DFINITY dapps can run on Ethereum and vice versa. As a consequence, engineers can choose to host dapps on the former ("Code is Law"), or they choose DFINITY, which allows for dapp upgrades or transaction reversal, stemming from the distributed intelligence rendered possible on-chain by the BNS. The BNS is a decentralized web of connected so-called neurons. The placed stake can vary from neuron to neuron and so can the relative voting power and promised rewards. To demotivate market exploiters, the monetization of deposits from neurons takes over three months. Each neuron

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[154] https://www.crunchbase.com/organization/dfinity-network, accessed February 26, 2019

[155] Identity (administrating new pseudonymous block miners; deposit required similar to PoS), Random Beacon (jointly produced verifiable, random function), Blockchain (probabilistic slot protocol (PSP)), and the notary (near-instant block finality) layer. Retrieved April 17, 2019, from https://dfinity.org/pdf-viewer/library/dfinity-consensus.pdf

[156] DFINITY does not claim to have an own blockchain per se, but to build an evolution of blockchain technology: https://dfinity.org/faq/is-the-internet-computer-a-blockchain

[157] The BNS ensures a coordinated way to maintain and enhance its system and consists of the phases of (1) proposal submission, (2) proposal evaluation and voting, and (3) decision enacting. As for proposal submission, proposals of any kind can be made on-chain in exchange for a deposit in dfinities (DFINITY's token); if approved, the deposit is returned, otherwise, the deposit will not be paid back. In the case of a refusal, the BNS does not vote on the suggested proposal at all and the proposing actor loses the placed security deposit. In case of adoption, the BNS votes on the proposal and the proposer has its security deposit returned. Similar to Tezos' delegation, the BNS provides a service that allows neuron-holding peers to define a follow list for each category. To improve its decision-making, intelligent algorithms parse through the follow lists and check in an order of precedence if one of the listed neurons already voted on this proposal or not. If this is the case, the voting decision of the followed neuron is adopted. Simplified, based on: https://medium.com/dfinity/the-dfinity-blockchain-nervous-system-a5dd1783288e

is able to vote on proposals with a strength relative to its staked value, and voting can be done either manually or automatically. Nonetheless, the BNS is only a theoretical construct and has not yet been tested in practice. We detail DFINITY's governance traits in the following.

11.4.6 Governance Traits of DFINITY

Coordination. To understand, how work is formalized, divided, and aligned in DFINITY, we now detail its actors along the transactional, technology development, and organizational layer. Within the status quo, on a transactional layer, there is no coordination analysis of the network and no proposal-voting process like in Aragon's or Tezos' network, as the BNS is not operational, yet. Instead, on the technology development and organizational layer, as we suppose, external contracting defines the current contract framework. The foundation is thereby a crucial coordinating actor since the foundation solely defines how resources are allocated and what is implemented by whom; the foundation thereby assigns and supervises work from development and research teams.

Similar to Aragon and Tezos, within the planned outcome, the influence of off-chain entities is planned to be downscaled once the system is fully running. While the coordinating role of the DFINITY foundation on the organizational and technology development layer would decrease, the future coordination of DFINITY would take place via on-chain consensus finding inside of the BNS. Three coordination mechanisms are seen as central to DFINITY: the (1) submission and examination of proposals, (2) voting, and (3) decision enacting. Similar to Aragon and Tezos, the BNS defines a sequence of steps as well as their outputs are standardized (standardizing of work processes/outputs).

Control. Here, we examine DFINITY's transactional, technology development, and organizational layer to understand, how control is exercised by whom within DFINITY. Due to the fact that DFINITY is not yet operational, we neglect the transactional layer in terms of control. As for the technology development and organizational layer, the current network consists of DFN holders only. Thereby, these holders do not have a direct control on the overall decision-making (unlike Aragon with its AGPP or Tezos with its amendment process). All other organizational building blocks are contemplated as external influencing factors. These include the (1) DFINITY foundation, (2) development bureaus, and (3) investors. The DFINITY foundation owns all rights to the system, manages all collected funds, and distributes them to development offices all around the world. Thus, the foundation not only controls funds but also its engineering bureaus.

As for the planned outcome, DFINITY plans a similar control mechanism to Aragon and Tezos. For one, as for the technology development and organizational layer, the BNS process also inheres a strong controlling next to its coordinating function. Here, development proposals are iteratively reviewed and voted upon; the network even will pay expert nodes to control the quality of proposals. In such a way, DFINITY allows users and experts to mutually control proposed developments.

Incentivization. To better understand the mutual dependence among the actors within DFINITY, we study applied incentivization along the transactional, technology development, and organizational layer in the following. As the system is not yet live, incentivization in the status quo on a transactional layer are not placed. On the technology development layer, token holders have the monetary incentive to hoard tokens, or to utilize the tokens to vote for changes to the system to their liking, which eventually serves their monetary incentivization. As for the organizational layer, the DFINITY foundation provides monetary incentivization (grants) to development teams to maintain and advance the system, while investors of DFINITY have the monetary incentivization to maximize their return on investment.

As for the planned outcome, several changes across all layers can be observed. As for the transactional layer, with the introduction of the BNS, DFN holders and neurons gain prominence, where neurons receive a mining reward for block validation or voting participation. As the probability for mining the next block corresponds with neurons at stake, the hoarding of DFN remains unchanged as main monetary incentive. This also holds true for the technology development layer, where neurons also act as (1) change proposers, (2) proposal evaluators, and (3) voters[158]. DFINITY thereby coupled the mining and voting procedures of neurons, which conflates system maintenance and altering. DFINITY thereby also plans to implement a reputation-based system labeled “trust-graph”[159], where a neuron’s voting history is ongoingly evaluated; in order to maintain a high portion of staked DFN, and hence, to be trusted, neurons are incentivized to build a good reputation. Within a proposal to alter the current system, in addition to a non-refundable fee that acts as a payment to researchers for proposal evaluation and a refundable security deposit as disincentive against

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[158] In order to operate a neuron, a holder of DFN has to deposit a certain amount to the BNS. This amount is called a security deposit and determines the neurons’ voting power and the proportionality of the earning rewards. This staking incentive applies to all types of neurons; with accumulative bad behavior, the value of the token might decrease in both the short- and long-term, which is why some owners might not retrieve their deposits in time for them to still be valuable. Retrieved April 17, 2019, from https://medium.com/dfinity/the-dfinity-blockchain-nervous-system-a5dd1783288e

[159] Retrieved April 15, 2019, from https://medium.com/dfinity/future-governance-integrating-traditional-ai-technology-into-the-blockchain-nervous-system-825ababf9d9

low-quality proposals, several formal requirements have to be met by the suggestion. These should create the incentivization for the proposer to prepare qualitative proposals such that the proposal-evaluating neurons get paid with their fee. Incentivization on the organizational layer is said to remain unchanged in the planned outcome.

11.5 Discussion

Our results have unpacked the complexity of DAOs, showing their main actual and planned novelties by depicting their applied coordination, control, and incentivization mechanisms, which answers RQ1. To prepare our discussion, we synthesize the cases' similarities and differences as follows:

- All of the cases in this study are frameworks that provide an infrastructure and tools to support the development and maintenance of dapps.
- Main internal actors are users, token holders, miners, and validators; the external ones are core-developers, project founders, leading figures, foundations as legal entities, and public authorities.
- A key coordination and control mechanism, that is planned in all cases to be automated on-chain, consists of suggestion of proposals, staking-based voting, and realization of decisions.
- The network tokens ANT, XTZ, and DFN are used both to maintain the system (higher chances of obtaining the next mining reward) as well as to alter the system; one's stake determines voting power.
- Currently, all cases are strongly affected by off-chain entities, especially by for-profit development teams, investors, researchers, and associations/foundations; the latter are central in terms of control.
- The operational systems of Tezos and Aragon seem to find little use in terms of the number of created dapps and active user/development accounts.
- All observed systems are stake-based and utilize delegated voting. So, there is risk that a plutocracy in the cards will be formed in which wealthy whales have the greatest decision-making power.

Where they differ (we only reflect here on the most striking differences):

- While Tezos' and DFINITY's endogenous governance happens at the protocol level, Aragon relies on governance structures on the dapp level; this is due to the lack of their own blockchain.

- Aragon's foundation explicitly intends to become a DAO itself, while others do not follow their credo to such a radical extend (dapp instead of DAO focus).
- Even though all of the cases use the blockchain technology as a backbone, their network objectives functionally diverge slightly (Self-governed DAO vs. Commonwealth vs. World Computer).

In the following, we derive learnings from our case observations by linking our main observations to associated concepts brought forward by our cases and the theoretical works introduced in chapter 11.2. This forms this paper's theoretical contribution and, thereby, answers RQ2.

Off-Chain Centrality and Lack of Use. It is four years since TheDAO was launched, and numerous DAO projects followed and evolved. Against a persisting hype, our studied projects can hardly claim to have achieved decentralized governance nor autonomous organizing at the time of writing, as shown in the gap between their current and planned outcome. Given large funds and time at hand, this is a surprising outcome and it points towards inhibitors that could not be overtaken, yet. As for decentralization and autonomy, technical decentralization is in place in terms of dispersion of nodes or transactions validation rights for Tezos and Aragon[160]. Organizationally, however, central authorities are in charge or, at least, highly influential on core decisions such as fund allocations or technical decisions, which is the case in all observed cases. This is not only seen in their non-profits, which often hold IPR or funds, but also in the limited number of development teams, who centralize technological expertise, which is also a known issue in other blockchain projects (De Filippi & Loveluck, 2016a); similar to other blockchains, influential figures for each of the studied projects are known. Further, our studied DAOs' autonomy – in the sense of independence from off-chain influences –, seems to be limited, as each of these span a web of on-/off-chain entities, seen, e.g., in their development teams. According to the two ways forward for blockchain governance (Miscione, Klein, et al., 2019), DAOs, at least for a certain time span, seem to combine both approaches, improved on-chain coordination and control while founding off-chain governing bodies; the latter are said to partly dissolve after bootstrapping its network and governance (in the case of Tezos and Aragon).

This all is not to say that DAOs are not progressing: Tezos only recently proved its on-chain amendment to work[161] and openly discusses ways onwards for their current system[162], while

[160] Tezos: https://tezblock.io/account/list, Aragon: https://www.etherchain.org/charts/topMiners
[161] https://cryptobriefing.com/tezos-surges-successful-protocol-upgrade/
[162] https://medium.com/tezos/amending-tezos-b77949d97e1e

Aragon launched a first version of its digital jurisdiction[163] and its most influential figure resigned to foster decentralization[164], to say the least. What remains remarkable, however, is the significant effort on upfront design decisions to optimize governance structures, which is in line with other research (Miscione, Klein, et al., 2019): a reductionist view on transaction cost efficiencies (Allen et al., 2020) oversees these development (production) costs (Garud & Munir, 2008). At the same time, their blockchains seem to find little use, which is surprising given their financial possibilities, as these three projects alone combined a warchest of >$1bln in assets at their peak. One might doubt to be dealing with vaporware – i.e., announced software/hardware, which is never actually implemented but promoted for reputational purposes.

In open networks, such as FOSS, innovation (disruptive or not) comes from the fringes: given these DAOs' possibilities, it remains interesting, why these infrastructures did not originate generativity (Zittrain, 2006), yet. Generativity does thereby not depend on capital but on large scale, free experimentation, where, out of countless efforts, very few successful services emerge. Then, because of positive network externalities, a winner tends to take all the organizational field. This is, hence, where one could argue these warchests to constitute a burden rather than an advantage: instead of experimenting freely on a large scale, legal issues and public feuds - well-exemplified by Tezos but also Aragon[165] and countless other ICOs - or token values became central. So, instead of legitimizing themselves on functioning governance, they swung for external legitimation, i.e. token's prices. In short, they exposed themselves to high market fluctuations beyond their own control, which they tried to tame with on-chain governance in the first place.

What (Who) are we building for? Aside from the question if blockchain use increases or not, governance is not independent from context, quite the contrary: context shapes the requirements, to which appropriate governance mechanisms are tailored to. For example, IT governance frameworks [166] first identify the context and then propose appropriate mechanisms to deal with these contexts. Consequently, without DAOs in use at scale, and without observable problems in practice, it remains unknown, if their upfront-developed governance mechanisms would match the future variety of a DAO's contexts. This problem recalls digital networks and their two-phase problem of growth: first they need to reach a

[163] https://cryptoticker.io/en/aragon-court-jurisdiction/
[164] https://blog.aragon.org/some-changes-at-the-aragon-association/
[165] https://thedefiant.substack.com/p/corrected-aragon-drama-pushes-on
[166] For example, COBIT: https://www.isaca.org/resources/cobit

critical mass to bootstrap by letting positive network externalities to kick in, i.e. users flock in and the network grows by itself. But then, when you have reached a certain scale, it becomes difficult to grow by adapting to different contexts for the simple reason that a large network opposes great inertia to changes (Hanseth & Lyytinen, 2010). In other words, on-chain governance may preserve the network openness that promises to unleash generativity (Zittrain 2006), and tame it later on by modulating and tailoring uses onto desired outcomes according to its own 'constitution'. Ideally, this double-layered on-chain governance (put forward by Tezos and DFINITY) solves this problem (functionalities that allowed to reach a critical mass are hard to change later) by offering 'constitutional' rules agreed upon ex-ante. If this works in practice remains to be seen as due to the gap between the actual developments and planned outcomes. However, as seen in our findings, tokens are a financial means of compensation for miners, but also a speculative investment for others. Thus, a main problem across the blockchain domain is the increasingly professionalized investment infrastructure around cryptocurrencies consisting of day traders, institutional, private investors and many more whose interests may diverge from other parties more than on-chain governance mechanisms can accommodate. Indeed, many of these actors are not interested in the technology itself, but in the gains they might earn, which they could cash out in the extreme case of infrastructure collapses. It appears contradictory to have a token as a speculative investment while using it as the incentive for system maintainers: if a significant amount of investors decide to pull their funds from the project to another, the token's value decreases, which effectively affects mining rewards and, consequently, system security. A similar logic applies to our studied DAOs, whose assets, which are vital for the DAOs continual survival, are often stored in forms of cryptocurrencies (own or external), whose values fluctuate.

Reducing discretionality. A reductive view on DAOs as gatherings of smart contracts is misleading (Murray et al., 2019). As depicted in our study, DAOs are highly intricate, socio-technical ecosystems, which are shaped by a context of internal as well as growing and changing external interests. All of our observed DAOs are similar for their goal of substituting both never-ending conflicts and off-chain authorities with on-chain governance processes to coordinate the network decentrally, while still adhering to its stakeholders, specifically to its designers, users, and maintainers. The goal is, hence, to limit discretional human intervention – and, as such, opportunism - once the system is running. Thereby, the question arises, for which reasons are which functions planned to be on-chain? Most of the planned on-chain processes regard consensus on demand management, system architecture choices and code development, and transaction reversals, which is in line with problems seen in other blockchain projects (Ziolkowski et al., 2020b) and it builds up on Bitcoin's/Ethereum's governance issues in the past (De Filippi & Loveluck, 2016a; DuPont, 2017). The vision/dream of minimal and streamlined human intervention remains misplaced because, as soon as contingences put us out of our comfort zone, the ease to handle algorithmically knowns are replaced by known unknows and even unknown unknowns, which have been illustrated with the case of TheDAO (DuPont, 2017). Therefore, these cases code rules "constitutionally" to change "law" code. For example, Tezos and DFINITY allow also to coordinate changes on-chain about the modality of coordination, funding, or others. Overall, the core idea of DAOs – marginalizing human intervention and automating processes – recall similarities to the cautionary tale of tightly coupled systems (Perrow, 2011): while trying to mitigate risks by avoiding uncertainty, a malfunctioning of single parts may cascade through the entire system (Ziolkowski et al., 2020b). Several of our interviewees confirmed the necessity of off-chain governance processes as a coordinated means of dealing with unforeseen situations. But of course, this brings discretionarily back in, and curbs the unleashed generativity of self-governed chains.

After linking related academic literature to our main empirical findings, we answer our research question two as follows:

- DAOs are no gatherings of smart contracts (Murray et al., 2019), but socio-technical ecosystems consisting of mutually dependent parties. Organizational processes are thereby increasingly ingrained and enacted on-chain, blurring the division between systems and organization (Miscione, Klein, et al., 2019).
- Even though motivated by strong enthusiasm, funds, and beliefs, DAOs face several inhibitors to decentralization and autonomy; it remains interesting, why these projects have not originated generativity, yet. One could argue that these DAOs may become the victims of their financial successes where, instead of experimenting freely on a large scale, legal issues or public feuds take center stage.
- Human intervention in DAOs is being displaced, transformed, but not marginalized. Instead of achieving autonomy, our DAOs showed the reliance on several central actors acting as gatekeepers, administrate funds, or to accumulate expertise, which reintroduces trust into a system, which was repeatedly considered trust-free (Beck et al., 2016; Jarvenpaa & Teigland, 2017).
- Shortcomings of "Code is law" (Lessig, 1999) are met with "Code is Constitution", where our studied DAOs show mechanisms to change fundamental processes, when need arises. As a consequence, blockchain's immutability, one of its core characteristics (Zheng et al., 2017a), is questioned.

- DAOs need to invest heavily up-front in governance structures, while their infrastructures find limited use, which draws similarities from studies on the Internet and their bootstrap problem (Hanseth & Lyytinen, 2010). Without considering infrastructure in practice, these upfront costs pass unseen, while only promises of more efficient transactions through smart contracts are highlighted, as several authors argue (Allen et al., 2020; Meijer & Ubacht, 2018).

11.6 Conclusion

This research studied three comparable and well-known DAOs, namely Aragon, Tezos, and DFINITY in terms of their applied coordination, control, and incentive mechanisms, to contribute to the growing research stream around blockchain governance and the underlying problems it addresses. Discussing the findings from our cases against a wider theoretical background confirmed the importance and extended our understanding of known concepts such as generativity, context, and in a wider sense, institutions.

This research is not free of limitations. First and foremost, our studied cases are partly still in development, which requires a follow-up study of their planned outcomes. While it is likely that core concepts will be implemented as promised, there is no guarantee, and other parts may not be implemented. Furthermore, governance, explicit or implicit, calcifies in practice and over time; we can only show a snapshot of these cases developments and plans at a given time. Further, there are many other DAOs, which are alike to our chosen cases. While we belief to have chosen relevant and well-documented cases, they certainly cannot represent all governance peculiarities DAOs bring about as, as we argued, governance is tied to context.

In conclusion, for further research, several lines could be considered. As we argue, blockchain organizing exceeds organizational boundaries while being originated in FOSS. The shared interest of multiple formally independent actors is thereby noteworthy and possible mechanisms to maintain their interests should be developed and studied, such as coordination, control, or incentivization mechanisms, but rather informal mechanisms like norms or trust, which proved explanatory for our cases. We encourage other researchers to continue to follow the development of our studied DAOs, especially in regard to how decision-making is taking place now that there is still informality in place in their online communities, blogs, or discussion sections, which, eventually, reflects their governance choices. Also, especially as seen in our cases, which often are reductively thought of as sets of smart contracts, it is worth considering whether those blockchain systems end up allowing users to have more influence on decisions, or if blockchain systems remain responsible only for what is automized by consensus algorithms. Finally, it could be illuminating to see if and how associations and central authorities go about their dissolution.

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