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Blockchain Technology and Inter-organizational Relationships

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BLOCKCHAIN TECHNOLOGY AND INTER-ORGANIZATIONAL RELATIONSHIPS

PhD Series 24.2021

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Blockchain technology and inter-organizational relationships

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Foreword

I would like to express my sincere gratitude to my supervisors, Henri Dekker and Morten Holm for their valuable advice and guidance during my doctoral studies at the Department of Accounting at Copenhagen Business School (CBS). I would never have been able to finish this dissertation without your encouragement, support and valuable feedback, more often than not provided under very tight timelines. Thank you for your infinite patience and motivation during the difficult parts of my studies. Both of you have acted as true role models and a source of inspiration both personally and academically. I could not have asked for better supervisors, and I am deeply grateful to both of you. I would also like to thank Thomas Riise Johansen, for being my secondary supervisor during the first year of my studies. Even though you were not officially my supervisor after a year or so, you were always more than willing to help and provide valuable feedback to help me improve my work.

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Last, but certainly not least, I would like to thank my parents Dragica and Branko Sedej for all the love and support throughout my life. Despite not having much yourselves, you always made sure I had everything I ever needed to develop into a person I am today. Thank you mom for making sure I always had more food on my plate than I could eat, and thank you dad for your detailed descriptions of all the dangers you had to overcome daily on your way to school as a kid. I would also like to thank my sister Sonja Sedej Mirtič and my brother in law Martin Mirtič for letting me use their beautiful new dining room table for writing a portion of this dissertation. If I had known that the table would come with such an inspiration and motivation to work, I would have asked for the access sooner. Also, thank you Sonja for keeping my mortadella in your fridge, and thank you Martin for providing valuable commentary during our watching of the NBA games. Those were a perfect remedy for PhD stress.

There is more people within my broader circle of family and friends I would like to thank, but this is not the place. Instead, I will invite you for a coffee, and tell you about blockchain. As long as you do not ask me whether or not you should start investing in Dogecoin.

Abstract

From their origins in cryptocurrencies, blockchains are emerging as an increasingly important organizational phenomenon. Blockchain is a software protocol allowing secure transfer of unique instances of value over the internet, without needing to rely on trusted intermediaries. It is analogous to a digital ledger that maintains a distributed, tamper-evident log of sequenced transactions, which are secured by a peer-to-peer network of autonomous computer nodes. The nodes collectively update the ledger, validate transactions and constantly monitor its integrity. By enabling a secure transfer of value between entities that do not necessarily know or trust each other, blockchains are essentially creating a new way of organizing economic transactions. In an enterprise setting, blockchain can be thought of as a shared information infrastructure, able to facilitate multi-party collaboration across organizational boundaries.

This thesis explores the potential of enterprise blockchain technology and its implications for inter-organizational relationships (IORs) focusing particularly on inter-organizational management accounting and control practices. IORs are both an interesting and intricate field of research. They can be defined as voluntary collaborative arrangements between legally autonomous organizations and can involve sharing of information, joint development of products and services, as well as a number of other partner contributions in terms of technology, capital, or firm-specific assets. Due to its multi-party nature, and its ability to distribute control among independent entities, blockchain could have a profound impact on the ways IORs are structured, potentially challenging some of the assumptions found in contemporary IOR literature.

To explore the implications of blockchain for the IORs, this thesis comprises three independent, yet interconnected research papers. The first paper reviews literatures from four pertinent areas of IORs, namely collaboration, trust, control and information exchange, with the explicit objective to synthesize extant knowledge about these topics, and discuss the potential implications of blockchain in each of these areas. Based on this discussion, the paper presents twelve propositions that constitute a research agenda, intended to serve as a guide for future research. The second paper discusses how and why organizations voluntarily engage in the process of technology standardization through collective action on an industry level. The arguments in the paper are developed through an in-depth investigation of two unique projects in the container shipping industry, namely TradeLens and INTTRA. TradeLens, one of the most prominent applications of enterprise blockchain technology today, is a blockchain-enabled supply chain platform, jointly

developed by Mærsk, a logistics conglomerate, and IBM, a multinational information technology company. INTTRA is an earlier attempt at creating an industry-wide technology standard. Funded by several major ocean carriers in the early 2000s, INTTRA is an EDI-based information exchange platform to support standard electronic bookings in the shipping ecosystem. Although created at different points in time, the two projects espouse a comparable goal of creating a common information infrastructure for the ocean freight industry. Based on the analysis of empirical data, the paper fleshes out three collective action trade-offs of central importance to technology standardization process. The third paper explores the process of building collaboration across the ecosystem, focusing particularly on specific blockchain system configurations with implications for the system's governance. Building on an in-depth analysis of rich qualitative data collected at TradeLens and several other actors in the shipping ecosystem, it identifies and delineates three key elements, crucial for influencing the willingness of ecosystems actors to engage in collaboration on an industry-wide blockchain network.

Resumé (Abstract in Danish)

Med rødder i kryptovaluta vinder blockchain nu frem som et mere og mere vigtigt fænomen i organisationer. Blockchain er en softwareprotokol, som baner vejen for sikre overførsler af unikke valutaer over internettet uden behov for betroede mellemmænd. Det svarer til en digital protokol, som fastholder en distribueret og manipulationssikret log af på hinanden følgende transaktioner, som sikres af et peer-to-peer netværk af autonome computernoder. Sammen opdaterer noderne protokoller, validerer transaktioner og monitorerer konstant deres integritet. Ved at facilitere en sikker overførsel af valuta mellem enheder, som ikke nødvendigvis kender eller stoler på hinanden, skaber blockchain helt basalt en ny måde at organisere økonomiske transaktioner på. I en virksomhedssammenhæng kan man se på blockchain som en infrastruktur for delt information, som kan facilitere samarbejde på tværs af organisatoriske grænser.

Denne afhandling udforsker potentialet i blockchainteknologi til virksomheder og dens betydning for inter-organisatoriske relationer (IOR) med særligt fokus på metoderne inden for inter-organisatorisk økonomistyring og kontrol. IOR er på én gang et interessant og kringlet forskningsområde. De kan defineres som frivillige samarbejdsaftaler mellem juridisk autonome organisationer og kan indebære deling af informationer, kollektiv udvikling af produkter og services samt et væld af andre partnerbidrag i form af teknologi, kapital eller virksomhedsspecifikke aktiver. Da blockchain kan distribuere kontrol over flere uafhængige enheder, kan blockchain have en dybtgående indvirkning på, hvordan vi strukturerer IOR, og kan potentielt udfordre nogle af de formodninger, vi gør os, i samtidens litteratur om IOR.

For at forstå blockchains betydning for IOR omfatter denne afhandling tre uafhængige men dog forbundne forskningsartikler. Den første artikel vurderer litteratur fra fire relevante områder inden for IOR, det være sig samarbejde, tillid, kontrol og udveksling af informationer, med det mål at forene eksisterende viden om disse emner og diskutere den potentielle betydning, blockchain kan have for hvert af disse områder. Baseret på denne diskussion præsenterer artiklen tolv forslag, der udgør en forskningsagenda fungerende som en guide til fremtidig research. Artikel nummer to diskuterer, hvordan og hvorfor organisationer frivilligt går ind i processen om at standardisere teknologier gennem kollektiv handling i en industri. Argumenterne i artiklen udfoldes gennem en dybdegående undersøgelse af to unikke projekter fra containershipping-industrien, TradeLens og INTTRA. TradeLens, en af de mest prominente applikationer inden for blockchain-teknologi i virksomheder i dag, er en blockchain-understøttet supply chain-platform, udviklet i et samarbejde

mellem Mærsk, et logistikkonglomerat, og IBM, en multinational virksomhed inden for informationsteknologi. INTTRA er et tidligere forsøg på at skabe en teknologistandard på tværs af industrier. Finansieret af flere store sø-fragt-virksomheder i starten af 2000'erne er INTTRA en EDI-baseret platform til deling af informationer og understøttelse af elektroniske bookinger inden for shipping-økosystemet. Selvom de to projekter har år imellem sig, støtter de begge et mål om at skabe en fælles infrastruktur for sø-fragt-industrien. Baseret på analyser af empiriske data uddyber artiklen tre afvejninger for kollektiv handling med central vigtighed for processen omkring teknologistandardisering. Den tredje artikel udforsker processen med at skabe samarbejde på tværs af shipping-økosystemet med specifikt fokus på systemkonfiguration af blockchain og indvirkningen på systemets styreform. Byggende på en dybdegående analyse af rig, kvalitativt data indsamlet fra TradeLens og andre aktører i shipping-økosystemet identificerer og beskriver artiklen tre hovedelementer med afgørende vigtighed, når det kommer til at influere økosystemets aktører til at indgå i samarbejde på tværs af brancher i et blockchain-netværk.

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Chapter 1: Introduction

Blockchain gained prominence as the underlying technology behind Bitcoin (Beck and Müller-Bloch 2017), a purely peer-to-peer payment system, introduced in a whitepaper by Satoshi Nakamoto in 2008. Digital currencies were the first functioning applications of the technology, but blockchain applications are rapidly expanding beyond the cryptocurrency space (Wörner et al. 2016). While currently the financial sector is leading the development of blockchain applications and business models, a number of firms from different industries, such as insurance, healthcare, shipping and entertainment have been implementing the technology over the past years (Beck et al., 2017; Bear and Rauchs, 2020; Lumineau et al., 2021).

In enterprise settings, blockchain can be seen as a shared information infrastructure (Bear and Rauchs, 2020), particularly useful for managing multi-party, inter-firm, and cross-border transactions (Van Hoek and Lacity, 2020). Based on its inherent characteristics, such as transparency, temper-evidence and distributed control (Rauchs et al., 2018, Swan, 2018, Rauchs er al., 2019) the technology could have a significant impact on the nature of governance of interfirm relationships (Caglio and Ditillo, 2020).

This thesis explores the implications of blockchain technology for inter-organizational relationships (IOR), with a particular focus on inter-organizational management accounting and control practices. It consists of three independent, yet interconnected, research papers, which comprise chapters 2, 3 and 4.

This chapter provides an overview of blockchain technology and positions the thesis in a broader field of accounting research. It shows how the three research papers are connected and concludes with thesis' overall contributions, limitations and implications for research and practice.

1. Blockchain

In 2008, a whitepaper by Satoshi Nakamoto outlined a purely peer-to-peer payment system called Bitcoin. The whitepaper described what seemed to be a robust framework for a currency that could run without backing of any government. Bitcoin proponents proclaimed that finance was about to enter the era of cryptocurrencies. Because the need for a trusted third party has traditionally been a domain of banks and financial institutions, this development may have meant that in the future, they will no longer be needed. This signaled a potentially much deeper change than the other inroads fintech has made on their business (The Economist, 2015a). Bitcoin's underlying technology, called a blockchain, was quickly recognized as the most promising aspect of the payment system, with potential to expand its applications beyond the cryptocurrency space. Proponents of blockchain predicted that it has the potential to not only remove dependencies from banks and other financial institutions, but also any other type of middlemen. They indicated that it might be able to change whole industries, establish an open, democratic, and scalable digital economy (Wang et al., 2016), and lower transaction costs at a scale at which the internet lowered communication costs (Kokina et al., 2017).

Blockchain is in essence a database, characterized by being decentralized, consensus-based and tamper-proof. The name "blockchain" refers to a chain of blocks, each containing a number of transactions. The transaction data is secured by cryptographic hash functions, which compress the block into a string of digits of a pre-defined length. Hash values are unique, and modifications of the block in a chain would instantly change the corresponding hash value (Nofer et al., 2017). Every block is linked to the preceding block, because it contains the hash of the preceding block in addition to the actual hashed transaction data (Beck et al., 2016; Nærland et al., 2017). Since the blockchain is extended by each additional block, it represents a complete ledger of transaction history. Besides the hashed transactional data and the hash of the previous block, each block contains a timestamp and a nonce, a random number for verifying the hash (Nofer et al., 2017). The blockchain is shared among a network of computers – known as nodes - which are incentivized to reach a consensus about the state of the blockchain (Nærland et al., 2017). If the majority of nodes agree, by a consensus mechanism, about the validity of transactions in a block as well as about the validity of the block itself, the block can be added to the chain (Beck et al., 2016; Nofer et al., 2017). All of the nodes in a blockchain network have an identical version of the blockchain, meaning that if one of the nodes dishonestly changes its version of the blockchain, this version would be rejected by all the other nodes. New entries can therefore only be accepted if they adhere to a pre-defined protocol, which makes the blockchain secure and temper-proof (Nærland et al., 2017). Moreover, since all the nodes have an identical copy of the blockchain, the network can still persist, even if certain nodes break down (Nofer et al., 2017).

The combination of these features is what make the blockchain attractive. The hashing algorithms ensure tamper-resistance and security, when used in a decentralized network (Beck et al., 2016). Blockchain is also transparent, because anyone with appropriate permissions can inspect all the blocks. Another desirable feature of the blockchain is peer-to-peer transmission, which, along with security and transparency, promises the disintermediation of costly intermediaries (Nofer et al., 2017). Certain blockchains (e.g. Ethereum[1]), allow users to set up the rules, known as smart contracts, that automatically execute, when certain pre-agreed conditions have been met. The concept of smart contract was already introduced in 1994 by Nick Szabo, but is becoming more popular with the advent of blockchain technology, since smart contracts can be applied more easily, compared to the technology available at the time of their invention (Nofer et al., 2017). Risius and Spohrer (2017) suggest that smart contracts can enable parties who do not fully trust each other, to conduct and control mutual transactions without depending on any trusted intermediary.

The first generation of blockchains, like Bitcoin's, provided a public ledger to store cryptographically signed financial transactions (Swanson, 2015). There was very limited capability to support programmable transactions, and only very small pieces of auxiliary data could be embedded in the transactions to serve other purposes, such as representing digital or physical assets. The second generation of blockchains, such as Ethereum's, provided a general-purpose programmable infrastructure with a public ledger that records the computational results (Xu et al., 2017). The third generation of blockchains (e.g. Cardano[2]) have been developed with a particular focus on creating a more efficient network, including wider functionality and improved scalability (Cummings, 2019).

Although Bitcoin is the first live application of blockchain, Rauchs et al., (2018) point out that the early occurrences of the concept can be traced back to the early 1990s. They refer to Haber and Stornetta (1991) and Bayer et al. (1993) who described the notion of cryptographically-linked chain of blocks to timestamp digital data in distributed systems in an efficient and secure manner using Merkle trees cryptographic hashing functions (Rauchs et al., 2018). Similarly, the first cryptocurrency was already described at the dawn of the internet in 1990 (Tasca and Tessone, 2018). The concept of distributed ledger can be traced back even further. Lamport et al. examined the Byzantine Generals Problem in 1982, and described how information systems must manage conflicting information in an adversarial environment (Castro and Liskov, 2002, Rauchs et al., 2018). Nakamoto's paper however, was the first to combine these concepts, and propose an electronic currency based on the blockchain (Tasca and Tessone, 2018).

[1] See: https://ethereum.org/en/
[2] See: https://cardano.org/

A thing to note at this point is the distinction between the terms distributed ledger technology (DLT) and blockchain. Albeit the terms are often used interchangeably, some authors (Rauchs et al., 2018; Swan, 2018) argue that they should not be considered identical. They suggest that blockchain is simply a subset of the broader DLT space that leverages a specific data structure consisting of a chain of cryptographically linked blocks of data (Rauchs et al., 2018). Swan (2018) points out that blockchains deployed in the enterprise context often do not use blocks at all. The debate about potential differences between the two concepts, however, remain unresolved to this day (Bear and Rauchs, 2020). Both blockchain and DLT have established themselves as an umbrella terms, and are often used synonymously (Rauchs et al., 2019). Consequently, this thesis uses both terms interchangeably.

Bitcoin's blockchain is an example of a public, permissionless blockchain. These types of blockchains are often described as "trustless", because users only need to establish trust in the software itself, rather than relying on human counterparties and intermediaries (Swan, 2018). In this setting, all nodes on the network can read the data, submit transactions, and participate in the validation process (Peters and Panayi, 2016). There are, however, different iterations of blockchain. In the context of public permissioned blockchains, all the nodes can read the data and submit transactions, but only predefined nodes are able to verify the transactions. Within private blockchains, only pre-approved nodes can read, submit or validate transactions (Nærland et al., 2017). In contrast to public permissionless type, private blockchains typically consist of identifiable, vetted participants, and can thus be characterized as "trusted" (Swan, 2018).

While a clear taxonomy has yet to be developed and agreed upon, blockchain networks can broadly be categorized based on the rights of participation (public and private) and the rights of validation (permissioned and permissionless). Plotting these dimensions results in four general types of blockchain networks, illustrated in Table 1.

<table>
<tr><th colspan="4">Types of blockchain networks</th></tr>
<tr><th colspan="4">Who can operate a validator node?</th></tr>
<tr><th colspan="2"></th><th>Permissionless
(Anyone)</th><th>Permissioned
(Requires permission, selection, or election)</th></tr>
<tr><th rowspan="2">Who can submit transactions?</th><th>Public
(Anyone)</th><td>Public-permissionless
• Bitcoin
• Ethereum
• Monero
• EOS (node validators)</td><td>Public-permissioned
• Ripple
• Libra
• EOS (block producers)</td></tr>
<tr><th>Private
(requires keys to access)</th><td>Private-Permissionless
• EY Ops Chain Public Edition</td><td>Private-permissioned
• MediLedger
• IBM Food Trust
• TradeLens</td></tr>
</table>

Table 1: Types of blockchain networks. Source: Lacity et al., 2019

This, however, is a high-level classification, omitting many nuances of different blockchain systems currently deployed in production environment. The characteristics of a particular blockchain system are contingent on several design considerations involved in building the system (e.g. data references, data diffusion). These design decisions are discussed in **Paper 1** and **Paper 3**. The properties of public permissionless networks, however, are still useful to understand, since many enterprise networks draw on the same type of distributed architectures, design principles, concepts and tools (Swan, 2018).

Private permissioned blockchains are the most common type of blockchains currently deployed in the enterprise settings, as they provide assurances of privacy, fast settlement, efficient use of resources, and regulatory compliance (Lacity et al., 2019). Enterprise blockchains are also the type of blockchains discussed in this thesis. They are the institutional response to public blockchains, aiming to transfer some of the acclaimed benefits to the corporate setting (Bear and Rauchs, 2020). Enterprise blockchains typically have some, but not all characteristics of public permissionless blockchains (Swan, 2018). Depending on the requirements of a particular use case, businesses implementing the technology have been relying on either all or only some of its components, such as distributed database and cryptographic hash functions. Rauchs et al. (2019) have termed the latter type “blockchain meme”, due to lack of multi-party consensus that characterizes public permissionless blockchains. They do not, however, consider one or the other category superior, and contend that the global impact of blockchain meme will likely be greater due to its potential to unleash enormous efficiency gains and create new services and business models.

The potential for creating a shared information infrastructure has drawn interest of many organizations (Swan, 2018; Bear and Rauchs, 2020; Van Hoek and Lacity, 2020; Lacity and Van Hoek, 2021). Over the past two years, a number of enterprise blockchain networks made a transition from pilot to production (Bear and Rauchs, 2020). Examples include TradeLens[3] (shipping), MediLedger[4] (pharmaceuticals), We.Trade[5] (trade finance) and IBM Food Trust[6] (product provenance) (Lacity et al., 2019; Rauchs et al., 2019; Lacity and Van Hoek, 2021).

Mapping the enterprise blockchain landscape can be difficult, given the proliferation of different projects across a range of industries (Bear and Rauchs, 2020). Blockchain researchers (e.g. Lacity et al., 2019, Bear and Rauchs, 2020) suggested different frameworks that could be used for classifying this expanding ecosystem. Building on a model proposed by Platt (2017), Rauchs et al. (2019) develop a particularly useful framework, organizing the ecosystem into three interconnected layers, namely protocol layer, network layer and application layer. Their framework is shown in figure 1.

[3] See: https://www.tradelens.com/
[4] See: https://www.mediledger.com/
[5] See: https://we-trade.com/
[6] See: https://www.ibm.com/dk-en/blockchain/solutions/food-trust

Figure 1: Enterprise blockchain ecosystem. Source: Rauchs et al., 2019

Protocols form a technical foundation of any blockchain network (Rauchs et al., 2018; Rauchs et al., 2019). Hyperledger Fabric[7], Enterprise Ethereum[8] and Corda[9] are dominant protocols, upon which a vast majority of contemporary enterprise networks is built (Bear and Rauchs, 2020). The network layer is based on a selected protocol and comprises a group of interconnected actors, transmitting information on a peer-to-peer network, producing a shared ledger of events (Platt, 2017; Rauch et al., 2018; Rauch et al., 2019). The majority of currently operational enterprise blockchain networks are hosted by large cloud providers (e.g. AWS, IBM, Microsoft, Oracle). Their entry to the enterprise blockchain market helped create additional credibility, and contributed to ecosystem expansion (Bear and Rauchs, 2020). Application layer comprises

[7] See: https://www.hyperledger.org/blog/2021/03/02/translating-hyperledger-fabric-documentation-into-multiple-languages
[8] See https://consensys.net/enterprise-ethereum/#:~:text=Enterprise%20Ethereum%20refers%20to%20a,chains%20and%20the%20public%20mainnet.
[9] See https://www.corda.net/platform-roadmap/

programs that connect to a network layer in order to support a particular use case and create actual business value (Platt, 207, Rauch et al., 2019).

The majority of enterprise blockchain networks in the current landscape are monolithic, meaning they are of private and permissioned type, and are typically organized around a narrow use case with one entity holding a disproportionate influence over the network (Bear and Rauchs, 2020). This, however, may change in the future, and the next generation of enterprise blockchains may be built on public networks (Lacity and Van Hoek, 2021). Ernst &Young (EY), for instance, recently launched Nightfall, a set of protocols allowing private transactions on a public Ethereum (Lacity et al., 2019) in anticipation of market pivot from private to public networks (Lacity and Van Hoek, 2021). The idea behind Nightfall is essentially creating a "virtual private blockchain", akin to virtual private network (VPN), connected to the public internet (Lacity et al., 2019; Lacity and Van Hoek, 2021). Bear and Rauchs (2020) similarly predict that currently prevalent monolithic networks will be replaced or superseded by semi-public, application-agnostic "super networks", which will support the development of numerous different use cases, possibly operating beyond industry boundaries.

2. Blockchain in accounting

Perhaps because of the intuitive link between the concept of the blockchain ledger and accounting ledgers, some authors began to consider the possibility of blockchain technology becoming a more secure, tamper-resistant alternative to contemporary accounting ledgers (Coyne and McMickle, 2017). The institute of chartered accountants of England and Wales (ICAEW), for instance, argues that blockchain is fundamentally an accounting technology, and that it holds the potential to increase the efficiency of the process of accounting for transactions and assets, operating as a system of universal entry bookkeeping. Blockchain has been called a "game changer" in accounting (Deloitte, 2016), and some commentators have even noted that the technology will make accountants "irrelevant" (Ovenden, 2017) and make the auditors and accounting firms "go away" (Patil, 2017). The potential of blockchain in accounting is also highlighted by the fact that each of the Big 4 accounting companies (Deloitte, KPMG, PwC and EY) started to engage in research and development within the blockchain space (Kokina et al., 2017).

Contemporary literature exploring the use of blockchain in accounting identifies several positive effects from the technology being applied to accounting and auditing practices. Most commonly mentioned benefits are increased speed and reduced costs of maintaining and reconciling ledgers

(ICAEW, 2017; Dai and Vasarhelyi, 2017), real-time accounting (Yermack, 2017), increased security and control (Peters and Panayi, 2016) and automation of accounting and auditing rules, which could be embedded on the blockchain (Krahel, 2012; ICAEW, 2017). Dai and Vasarhelyi (2017) also suggest that blockchain could facilitate “triple entry-accounting”, where it could play the role of neutral intermediary in order to enhance the reliability of company’s financial statements. The authors propose that every account in contemporary double-booking system, could have a corresponding blockchain account.

Not all authors are as optimistic regarding blockchain’s applicability in accounting settings. Coyne and McMickle, (2017) for example, suggest that blockchain verification methods are insufficient for transaction validity from an accounting perspective, because maintainers of these blockchains do not know anything about the true validity of the transaction. They only know if the transaction uses unspent inputs and is digitally signed. As such, they argue, blockchain cannot prevent erroneous measurement of transactions and asset misappropriation. This issue stems from the difference between asset transfer (i.e. a transaction) and the recording of asset transfer (i.e. financial reporting). Unlike Cryptocurrencies, which only exist within blockchain, economic transactions exist outside of accounting records (Coyne and McMickle, 2017). While asset ownership might be verifiable by blockchain records, its condition, location and true worth must still be assured (ICAEW, 2017). O’Leary (2017) also demonstrates why the technology cannot serve an accounting purpose, using different types of blockchains. In his view, open public blockchains remove information asymmetry, which could potentially provide competitors with an access to an entire set of transactions. Even though blockchain can be used to encrypt the data in each transaction, the transactions must be made public if the provenance or ownership of assets is at stake (ICAEW, 2017). Private blockchains on the other hand, provide more security, because only authorized parties are allowed to add transaction blocks to the chain. There are, however, existing transaction systems that already do this, and there is already considerable experience with such systems (O’Leary, 2017). In a completely private blockchain, the company automatically fully controls transaction verification, and would be able to rewrite any portion of the blockchain (Coyne and McMickle, 2017). O’Leary (2017) also addresses the issues related to private blockchains shared across a group of organizations (i.e. consortium blockchains). In this setting, he argues, there are likely to be power differences, so it is unclear if the consensus mechanisms would be an appropriate solution.

Management control systems (MCS) represent another area of accounting that could potentially be disrupted by blockchain technology. Simons (1995) defines MCS as formal, information-based routines and procedures, used by managers in order to maintain or change patterns in organizational activities. He classifies them as belief systems, boundary control systems, diagnostic controls systems and interactive controls. Different authors, however offer different classifications. Otley (1999) for instance, classifies them as objectives, strategy implementation, rewards and incentive structure, target setting and performance measurement and information feedback loops. Merchant and Van der Stede (2007), on the other hand, differentiate between action controls, result controls and personnel and cultural controls. Yet another classification is provided by Malmi and Brown (2008) who propose MCS as a package. Their typology encompasses cybernetic controls, planning controls, cultural controls, administrative controls and reward and compensation controls. The ultimate goal of MCS is to supply managers with the information which should allow them to build and maintain the desired behavioral patterns within the firm (Otley, 1999).

A common thread running across these different categorizations is the collection and exchange of information. Studies focusing on management accounting and exchange of information found that information technology is a critical enabler of management control practices (e.g. Burns and Vaivo, 2001; Beaubien, 2015; Rikhardsson and Yigitbasioglu, 2018). A number of contributions dealing with the impact of information technology on management accounting (e.g. Bhimani and Langfield-Smith, 2007; Bhimani and Willcocks, 2014; Appelbaum et al., 2017; Rikhardsson and Yigitbasioglu, 2018) has been made in the past two decades. Appelbaum et al. (2017), for instance, observe that information technology can assist management accountants in supplying the managers with relevant data and offer support in control and decision-making processes. Some authors (e.g. Caglio, 2003; Scapens and Jazayeri, 2003) further suggest that new technologies not only tighten organizational controls, but may also allow new forms of control, which were not possible before the introduction of information technology. Caglio (2003) and Jack and Kholeif (2008), however, caution that the outcomes are not necessarily predictable (Beaubien, 2015).

Blockchain could be seen as a new instance of information technology, able to transform management control practices. Bhimani and Willcocks (2014) observe that information technology changes invariably change the collection and analysis for management control activities. Blockchain's characteristics, which include peer-to-peer transmission, shared recordkeeping, multi-party consensus, independent validation, tamper resistance, tamper evidence, and transparency (Rauchs et al., 2019), seem especially useful for supporting exchange of information and simplifying MCS. Introducing blockchain could help firms establish a secure, tamper-evident log of transactions, routinize and automate certain control practices, allow for a systematic collection of data and provide managers with dependable information, to support decision making process and enable better control. While blockchains are an important advancement, they are not a panacea (Swan, 2018). Lumineau et al. (2021), for instance, caution that blockchains can only automate practices and agreements that can be clearly specified, and when outcomes are verifiable. Another potential issue is the quality of data. Many enterprise blockchains currently in production are used to handle information exogenous to the blockchain system (e.g. tracking the movement of goods). This issue has been referred to by the authors as the gateway problem (Halaburda, 2018) or as the oracle problem (Murray et al., 2019). The gateway problem describes potential issuess with automatic enforcement based on inaccurate data that is fed into the blockchain system, as well as the requirement to add verifiers to ensure the dependability of the exogenous data (Xu et al. 2017). In other words, while blockchain can ensure that the data recorded on the blockchain is secure, it does not, by itself, prevent the recording of low quality or erroneous data.

While the implications of blockchain technology on MCS seem like a fruitful area for research, they are not the core topic of this thesis. One of the reasons is the novelty of blockchain technology. Even though Bitcoin, as the first live blockchain application, already went live in 2009, the potential benefits of the technology were not immediately evident to enterprises (Lacity and Van Hoek, 2021). Core protocols enabling enterprise blockchain networks went live as late as 2016 (Corda) and 2017 (Enterprise Ethereum and Hyperledger fabric). As such, the use of technology in an enterprise setting is still relatively recent, and the functionalities of a particular implementation and their implications on businesses are yet to be explored. Practitioners and academics often uncritically transplant the characteristics of Bitcoin's public permissionless blockchain (e.g. immutability, trust, transparency with pseudonymity) to an enterprise setting. The characteristics of a particular blockchain, however, will vary between different implementations, based on design decisions. It is thus important to consider both the specifics of a particular implementation as well as how the resulting characteristics interact with the MCS. At the time when I started writing this dissertation (2017), however, still a very limited number of functioning enterprise blockchain systems existed. At the same time, organizations across various industries were running Proof of Concepts, and increasingly ran into issues identified in the literature on inter-organizational relationships, such as achieving effective coordination, selecting appropriate partners and establishing efficient inter-firm control mechanisms to prevent opportunism. This presented a very interesting research opportunity, that of investigating blockchain technology in the context of IORs.

3. Blockchain and inter-organizational relationships

Inter-organizational collaboration is a key source of competitive advantage for many organizations, because it enables value creation through accessing and combining complementary resources and capabilities from partner firms (Dyer and Singh 1998). Management control of such partnerships however, poses a considerable control challenge to management accountants, due to conflicting incentives among participating organizations and the complexity of coordination between them. The difficulty of measuring individual contributions to a shared output can generate an incentive for opportunistic behavior, because partners are tempted to free-ride and conceal information (Coletti et al., 2005).

The need for control of inter-firm relationships has been proposed by Otley in 1994, who argued that management control is no longer confined within the legal boundaries of the organization, and Hopwood (1996) who identified the need for investigating the lateral processing of information, transcending legal boundaries of the company. Consequently, a number of studies in accounting and economics (e.g. Williamson 1993; Tomkins, 2001; Dekker, 2004; Caglio and Ditillo, 2008; Vosselman and van der Meer-Kooistra, 2009) has been published over the past two decades, dealing with the topic. Many of these studies discuss coordination and opportunism as notable management control issues with implications for inter-organizational relationships. Opportunism has been described as self-interest seeking with guile, and more broadly refers to intentional incomplete or distorted information disclosure between transaction partners (Williamson, 1985). This self-interested behavior can take many forms, such as shirking, under-provision of effort and poaching (Clemons and Hitt, 2004). These can create transaction hazards (Williamson 1985) and tension between partners, which mandates that different formal and informal safeguards be put in place to alleviate those hazards and manage the IOR. Such safeguards can mitigate some of the concerns related to partners' opportunism, by changing incentives for opportunistic behavior, and thereby contribute to the value creation in inter-company relationships (Dekker, 2004; Coletti et al. 2005; Mahama, 2006).

An important enabler of these safeguards are the technologies for collecting, disseminating and monitoring information within and across organizational boundaries (Gulati and Singh 1998). In this context, the blockchain, which The Economist (2015b) labelled as the "trust machine", seems like a particularly useful tool to solve disclosure and accountability problems among parties whose interests are not necessarily aligned (Casey and Wong, 2017). Its inherent characteristics could help improve reliability and ex post observability of records shared between partners, as well as reduce information asymmetry, which is seen as a source of power in relationships (Mahama, 2006), and the main origin of opportunism risk (Clemons and Hitt, 2004). Blockchain could, in this context, be viewed as an accountability system (Mahama, 2006), which facilitates information gathering and promotes information sharing through feedforward and feedback loops. The resulting transparency could serve to align the efforts of relationship participants, ensure they equally take responsibility for producing collective benefits and reduce their tendency to engage in free-riding and social loafing (Mahama, 2006). Additionally, the use of programmable self-executing rules (i.e. smart contracts) could enable automated enforcement of interactions between partners, further narrowing the domain around which parties can act opportunistic (Poppo and Zenger, 2002). As such, the use of blockchain may potentially challenge some of the conclusions reached thus far in the IOR literature (Caglio and Ditillo, 2020).

Despite the immense potential of applying blockchain technology to IOR settings, and despite recent calls in the literature (e.g. Caglio and Ditillo, 2020), there is still a dearth of empirical research dealing with the topic. This may be because several enterprise blockchain projects only recently moved from the Proof of concept (PoC) stage to production environment and became operational. Their deployment has been slow, because considerations such as governance arrangements, incentive alignments and regulatory issues have led to significant delays (Bear and Rauchs, 2020; Van Hoek and Lacity, 2020). Because blockchains employed in enterprise settings can be thought of as an information infrastructure shared between a number of organizations, often including rivals (Lacity et al., 2019; Jensen et al., 2019), their successful deployment hinges on the ability of participating firms to overcome the difficulties of working together (Lacity and Van Hoek, 2021; Van Hoek and Lacity, 2020). In a recent study, Lacity and Van Hoek (2021) found that the technology itself is the easier part of blockchain implementations, and is often just a backstory. They argue that the most difficult part in enterprise blockchains deployments is establishing collaboration between partners in order to benefit from technological capabilities. The blockchain initiatives included in their study were business-led projects, which aspired to resolve ecosystem-level problems, which turned out to be particularly suited for blockchain. In other words, they were "blockchain-enabled", rather than "blockchain applications" (Lacity and Van Hoek, 2021). Other blockchain researchers (e.g. Mattke et al., 2019; Jensen et al., 2019; Zavolokina et al., 2019), report similar results, indicating that building collaboration across a network of participating organizations and navigating tensions between them are necessary preconditions for successful deployment of blockchain networks.

With this in mind, the overall research questions addressed in this thesis are: (1) What are the implications of blockchain technology for inter-organizational relationships?; and (2) What are the factors contributing to the deployment of the enterprise blockchain network and how are they influenced by the relationship dynamics between IOR partners?

To answer these questions, **Paper 1** conceptualizes blockchain as an inter-organizational information infrastructure, with implications for transaction hazards (Williamson 1985) and the corresponding formal and informal management control mechanisms in IOR settings. It outlines integral technical features of a permissioned blockchain and proposes the technology as an empirical concept with implications for management accounting practices that underpin inter-organizational collaboration, trust, control, and information exchange. It then reviews literatures within each of these areas with a particular focus on management control issues, identifies recurring and salient themes, and considers how each could be affected by the blockchain technology. Particular focus of the analysis is on the interplay between the technical capabilities of blockchain and inter-organizational management control procedures. Based on this discussion, twelve propositions that constitute a research agenda are developed. These propositions are intended to serve as a guide for future research within identified areas. Paper 1 was presented at the Accounting Horizons Conference on "Data Analytics in Accounting" in December 2019. At the time of this writing, the paper has been received from the second round of review at the Accounting Horizons journal, requiring some minor changes. It will soon be resubmitted to the journal.

Paper 2 provides a discussion on how and why organizations voluntarily engage in the process of technology standardization through collective action on an industry level. More specifically, it seeks to clarify how a group of organizations can produce an industry standard through contributions to an inter-organizational information infrastructure. This paper is technology agnostic, meaning that it does not specifically consider particularities of the blockchain technology and their effects on standardization efforts. Rather, blockchain is here seen as one of the instances of technologies that could enable the creation of a shared inter-organizational information infrastructure, which can be seen as the “blueprint” for the interaction patterns between organizations (Zhao and Xia 2014; Christ and Nicolaou, 2016). This is because blockchain is in essence, a multi-party technology (Glaser, 2017), meaning that the central challenge of a blockchain deployment is establishing collaboration between trading partners, including competitors (Lacity et al., 2019). While organizations strive to facilitate mutual value creation through information exchange and process integration with industry partners, they also constantly need to make decisions to safeguard their commercial interests (Schloetzer, 2012). This creates a unique type of dependency between firms, where a resolution to these challenges can only arise through some form of collective action, which is the topic of **Paper 2**. The paper provides an analysis of two industry-wide technology standardization efforts in the container shipping industry, namely INTTRA and TradeLens, and applies a collective action theory lens to understand the factors that influence technology standardization dynamics as they unfold over time. Based on the analysis of the two projects, three critical collective action trade-offs, namely flexibility vs inclusion; generalizability vs completeness; and investment vs value capture, are proposed as analytical tools for investigating how technology standardization through collective action on an industry level arises and evolves. At the time of this writing, this paper has been submitted for a special issue on Standards and Innovation at the Research Policy Journal.

Paper 3 similarly explores the process of building collaboration across the ecosystem, but does so on a more granular level, with a focus on the particularities of blockchain system configuration and specific transaction hazards facing organizations looking to join a blockchain network. It empirically develops the arguments through an in-depth case study of TradeLens, a supply chain platform, underpinned by blockchain technology, jointly developed by Mærsk, a logistics conglomerate, and IBM, a multinational information technology company. The paper provides a detailed discussion of specific design considerations inherent in blockchain systems (e.g. data diffusion, network access, data processing), and illustrates how the resulting characteristics influence system governance. Data analysis identifies and delineates three key elements, namely value creation, governance and interoperability that are of crucial importance for establishing collaboration on an industry-wide blockchain-based platform. The paper then outlines specific transaction hazards facing organizations looking to engage in inter-firm collaboration on a blockchain network, and proposes how they can be addressed by the identified elements. This paper will be submitted to Technological Forecasting and Social Change journal in June, 2021.

4. Overall contributions, limitations and implications for future research

While each of the three papers separately outlines its contributions, limitations and implications for research and practice, this section summarizes thesis' overall contributions, limitations and implications. Taken as a whole, this dissertation contributes to advancing our understanding of the potential of blockchain technology in inter-organizational settings. By integrating arguments on blockchain and IORs from various fields of research, it offers a holistic perspective of the management control implications of blockchain for the IORs.

First, it positions blockchain as a novel instance of inter-organizational information infrastructure, which necessitates contributions from a number of actors in the network, and requires a considerable amount of ex ante coordination. Accordingly, the organizing and structuring of these relationships are the explicit topic of papers 2 and 3. As such, the findings of the thesis contribute to our understanding of the dynamics of direct horizontal relations among rivals, as well as indirect horizontal relations between complementors (Caglio and Ditillo, 2020). Second, the findings presented in this dissertation show how technical characteristics of a particular blockchain system interact with the nature of transactions among IOR partners. Relatedly, this thesis clarifies some common misconceptions about the characteristics of enterprise blockchain technology often found in the literature (e.g. immutability). It highlights the differences between different blockchain system configurations, and outlines how they influence the system's governance. Contrary to early contributions (e.g. Ovenden, 2017), findings presented below suggest that characteristics of blockchain technology do not make management control obsolete, especially when the technology is used for managing data residing outside the system. When a blockchain system is used to handle data exogenous to the system, "traditional" management controls are still necessary (i.e. to address the gateway problem).

Findings of the thesis further suggest that practitioners, seeking to engage with the technology, should understand that blockchain is fundamentally a multi-party system, meaning it will invariably involve a network of actors, whose interests may not necessarily be aligned. As such, organizations should carefully consider the governance arrangements, align expectations and agree on how the value created by the blockchain system is distributed among them. Organizations looking to join an existing blockchain network should understand the parameters of the system and corresponding transaction hazards. On the other side of the coin, the founders of blockchain systems need to find a balance between maintaining a sufficient level of influence over the system to meet their own interests, while remaining cognizant of the needs of a broader ecosystem. Because building and maintaining collaboration across the network of actors is central for successful deployment of the blockchain system, founders should make sure to give up enough control over the shared infrastructure, to ensure potential adopters they are not trying to promote their own interests at the detriment of others.

This dissertation is subject to several limitations. It is primarily concerned with private, permissioned monolithic blockchain networks, which are the prevalent type in the contemporary enterprise blockchain landscape. The ecosystem, however, will develop in the future, perhaps moving from monoliths to semi-public super networks (Bear and Rauchs, 2020). This shift may possibly challenge some assumptions presented in this thesis. Additionally, empirical data was collected predominantly from respondents involved with the shipping industry, and may not generalize beyond the ecosystem. Additionally, case study method employed in papers 2 and 3 can restrict statistical generalizability of findings, and is potentially a subject to researcher-induced bias both during data collection and analysis (Yin, 2009).

Nonetheless, the insights from this thesis could provide a fruitful ground for novel research in the future. Research agenda presented in Paper 1 could serve as a useful starting point for management accounting scholars to further explore the implications of blockchain for the IORs. Future studies could also investigate the interplay between technical characteristics of a particular blockchain implementation and different MCS frameworks (e.g. Malmi and Brown, 2008). Researchers could further explore the implications of different types of blockchain networks (e.g. virtual private blockchains, super networks) for management control of the IORs. Further, the fourth generation of blockchains is expected to be integrated with other novel technologies, such as the Internet of Thins (IoT) and Artificial Intelligence (AI) (Cummings, 2019). Future studies could explore how the combination of technologies influences management accounting and control.

Blockchain has been described as a disruptive technology, holding the potential to revolutionize businesses and technology landscapes (Lacity and Van Hoek, 2021), fundamentally alter the nature of collaborations (Lumineau et al., 2021) and even change the way societies are organized (Atzori, 2015). The technology, however, is still relatively novel. Its continued evolution will likely open a number of possible avenues for research across a number of disciplines, including accounting, economics and operations management.

References

Appelbaum, D., Kogan, A., Vasarhelyi, M., & Yan, Z. (2017). Impact of business analytics and enterprise systems on managerial accounting. *International Journal of Accounting Information Systems, 25*, 29-44.

Atzori, M. (2015). Blockchain technology and decentralized governance: Is the state still necessary?. *Available at SSRN 2709713*.

Bayer, D., Haber, S., & Stornetta, W. S. (1993). Improving the efficiency and reliability of digital time-stamping. *In Sequences Ii* (pp. 329-334). Springer, New York, NY.

Bear, K. & Rauchs, M. (2020). *Financial Services Leads The Development Of Enterprise Blockchain*. Available at: https://www.gdf.io/wp-content/uploads/2020/11/GDF-FS-Leads-The-Development-of-Enterprise-Blockchain-Vignette-October-2020.pdf

Beaubien, L. (2013). Technology, change, and management control: a temporal perspective. *Accounting, Auditing & Accountability Journal*.

Beck, R., & Müller-Bloch, C. (2017, January). Blockchain as radical innovation: a framework for engaging with distributed ledgers as incumbent organization. In *Proceedings of the 50th Hawaii International Conference on System Sciences*.

Beck, R., Stenum Czepluch, J., Lollike, N., & Malone, S. (2016). Blockchain–the gateway to trust-free cryptographic transactions.

Beck, R., Avital, M., Rossi, M., & Thatcher, J. B. (2017). Blockchain technology in business and information systems research.

Bhimani, A., & Langfield-Smith, K. (2007). Structure, formality and the importance of financial and non-financial information in strategy development and implementation. *Management accounting research, 18*(1), 3-31.

Bhimani, A., & Willcocks, L. (2014). Digitisation,'Big Data'and the transformation of accounting information. *Accounting and Business Research, 44*(4), 469-490.

Burns, J., & Vaivio, J. (2001). Management accounting change. *Available at SSRN 289124*.

Caglio, A. (2003). Enterprise resource planning systems and accountants: towards hybridization?. *European Accounting Review, 12*(1), 123-153.

Caglio, A., & Ditillo, A. (2008). A review and discussion of management control in inter-firm relationships: Achievements and future directions. *Accounting, Organizations and Society, 33*(7-8), 865-898.

Caglio, A., & Ditillo, A. (2020). Reviewing interorganizational management accounting and control literature: a new look. *Journal of Management Accounting Research*, 0000-0000.

Casey, M. J., & Wong, P. (2017). Global supply chains are about to get better, thanks to blockchain. *Harvard business review, 13,* 1-6. Available at: https://hbr.org/2017/03/global-supply-chains-are-about-to-get-better-thanks-to-blockchain

Castro, M., & Liskov, B. (2002). Practical Byzantine fault tolerance and proactive recovery. *ACM Transactions on Computer Systems (TOCS), 20*(4), 398-461.

Christ, M. H., & Nicolaou, A. I. (2016). Integrated information systems, alliance formation, and the risk of information exchange between partners. *Journal of Management Accounting Research, 28*(3), 1-18.

Clemons, E. K., & Hitt, L. M. (2004). Poaching and the misappropriation of information: Transaction risks of information exchange. *Journal of Management Information Systems, 21*(2), 87-107.

Coletti, A. L., Sedatole, K. L., & Towry, K. L. (2005). The effect of control systems on trust and cooperation in collaborative environments. *The Accounting Review, 80*(2), 477-500.

Coyne, J. G., & McMickle, P. L. (2017). Can blockchains serve an accounting purpose?. *Journal of Emerging Technologies in Accounting, 14*(2), 101-111.

Cummings, S. (2019). *The Four Blockchain Generations*. Available at: https://medium.com/the-capital/the-four-blockchain-generations-5627ef666f3b

Dai, J., & Vasarhelyi, M. A. (2017). Toward blockchain-based accounting and assurance. *Journal of Information Systems, 31*(3), 5-21.

Dekker, H. C. (2004). Control of inter-organizational relationships: evidence on appropriation concerns and coordination requirements. *Accounting, organizations and society, 29*(1), 27-49.

Deloitte (2016). *Blockchain technology: A game changer in accounting*. Available at:

https://www2.deloitte.com/content/dam/Deloitte/de/Documents/Innovation/Blockchain_A%20game-changer%20in%20accounting.pdf

Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of management review, 23*(4), 660-679.

Glaser, F. (2017, January). Pervasive decentralisation of digital infrastructures: a framework for blockchain enabled system and use case analysis. In *Proceedings of the 50th Hawaii international conference on system sciences.* Available at: https://pdfs.semanticscholar.org/859d/0535e16095f274df4d69df54954b21258a13.pdf

Gulati, R., & Singh, H. (1998). The architecture of cooperation: Managing coordination costs and appropriation concerns in strategic alliances. *Administrative science quarterly*, 781-814.

Haber, S., & Stornetta, W. S. (1990, August). How to time-stamp a digital document. In *Conference on the Theory and Application of Cryptography* (pp. 437-455). Springer, Berlin, Heidelberg.

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

Hopwood, A. G. (1996). Looking across rather than up and down: on the need to explore the lateral processing of information. *Accounting, Organizations and Society, 21*(6), 589-590.

Iansiti, M. & Lakhani, K.R. (2017). The Truth About Blockchain. *Harvard Business Review*. Available at: https://hbr.org/2017/01/the-truth-about-blockchain

ICAEW (2017). Blockchain and the future of accountancy. *Available at:* https://www.icaew.com/en/technical/information-technology/technology/blockchain/blockchain-and-the-accounting-perspective

Jack, L., & Kholeif, A. (2008, March). Enterprise resource planning and a contest to limit the role of management accountants: a strong structuration perspective. *In Accounting Forum* (Vol. 32, No. 1, pp. 30-45). No longer published by Elsevier.

Jensen, T., Hedman, J., & Henningsson, S. (2019). How TradeLens Delivers Business Value With Blockchain Technology. *MIS Quarterly Executive, 18*(4).

Kokina, J., Mancha, R., & Pachamanova, D. (2017). Blockchain: Emergent industry adoption and implications for accounting. *Journal of Emerging Technologies in Accounting*, *14*(2), 91-100.

Krahel, J. P. (2012). *On the formalization of accounting standards* (Doctoral dissertation, Rutgers University-Graduate School-Newark).

Lacity, M.C., Steelman Z., & Cronan, P. (2019). Blockchain Governance Models: Insights for Enterprises [White paper]. *Available at:* https://cpb-us-e1.wpmucdn.com/wordpressua.uark.edu/dist/5/444/files/2019/11/BCCoEWhitePaper022019OPEN.pdf

Lacity, M., & Van Hoek, R. (2021). What We've Learned So Far About Blockchain for Business. *MIT Sloan Management Review*, *62*(3), 48-54.

Lamport, L., Shostak, R., & Pease, M. (2019). The Byzantine generals problem. In *Concurrency: the Works of Leslie Lamport* (pp. 203-226).

Lumineau, F., Wang, W., Schilke, O. & Huang, L. (2021). How Blockchain Can Simplify Partnerships. *Harvard Business Review*. *Available at:* https://hbr.org/2021/04/how-blockchain-can-simplify-partnerships#:~:text=Blockchains%20fundamentally%20alter%20each%20phase,can%20dramatically%20simplify%20this%20step.

Mahama, H. (2006). Management control systems, cooperation and performance in strategic supply relationships: A survey in the mines. *Management Accounting Research*, *17*(3), 315-339.

Malmi, T., & Brown, D. A. (2008). Management control systems as a package—Opportunities, challenges and research directions. *Management accounting research*, *19*(4), 287-300.

Mattke, J., Hund, A., Maier, C., & Weitzel, T. (2019). How an Enterprise Blockchain Application in the US Pharmaceuticals Supply Chain is Saving Lives. *MIS Quarterly Executive, 18*(4).

Merchant, K. A., & Van der Stede, W. A. (2007*). Management control systems: performance measurement, evaluation and incentives.* Pearson Education.

Murray, A., Kuban, S., Josefy, M., & Anderson, J. (2019). Contracting in the smart era: The implications of blockchain and decentralized autonomous organizations for contracting and corporate governance. *Academy of Management Perspectives*, (ja).

Nakamoto, S. 2008. Bitcoin: A peer-to-peer electronic cash system. Available at: https://bitcoin.org/bitcoin.pdf

Nofer, M., Gomber, P., Hinz, O., & Schiereck, D. (2017). Blockchain. *Business & Information Systems Engineering*, *59*(3), 183-187.

Nærland, K., Müller-Bloch, C., Beck, R., & Palmund, S. (2017, December). Blockchain to Rule the Waves-Nascent Design Principles for Reducing Risk and Uncertainty in Decentralized Environments. In *ICIS*.

O'Leary, D. E. (2017). Configuring blockchain architectures for transaction information in blockchain consortiums: The case of accounting and supply chain systems. *Intelligent Systems in Accounting, Finance and Management*, *24*(4), 138-147.

Otley, D. (1994). Management control in contemporary organizations: towards a wider framework. *Management accounting research*, *5*(3-4), 289-299.

Otley, D. (1999). Performance management: a framework for management control systems research. *Management accounting research*, *10*(4), 363-382.

Ovenden, J. (2017). Will blockchain render accountants irrelevant? *Available at:* https://channels.theinnovationenterprise.com/articles/will-blockchain-render-accountants-irrelevant

Patil, H. (2017). 22 ways that blockchain will change the accounting profession forever. CPA Trendlines. *Available at* http://cpatrendlines.com/2017/07/03/22-ways-blockchain-will-impact-accounting-profession/

Peters, G. W., & Panayi, E. (2016). Understanding modern banking ledgers through blockchain technologies: Future of transaction processing and smart contracts on the internet of money. In *Banking beyond banks and money* (pp. 239-278). Springer, Cham.

Platt, C., (2017). Of permissions and blockchains… A view for financial markets. *Available at*: https://medium.com/@colin_/of-permissions-and-blockchains-a-view-for-financial-markets-bf6f2be0a62

Poppo, L., & Zenger, T. (2002). Do formal contracts and relational governance function as substitutes or complements?. *Strategic management journal*, *23*(8), 707-725.

Rauchs, M., & Bear, K. (2019). Financial Services Leads The Development Of Enterprise Blockchain. *Available at:* https://www.gdf.io/wp-content/uploads/2020/11/GDF-FS-Leads-The-Development-of-Enterprise-Blockchain-Vignette-October-2020.pdf

Rauchs, M., Glidden, A., Gordon, B., Pieters, G. C., Recanatini, M., Rostand, F., Vagneur, K. & Zhang, B. Z. (2018). Distributed ledger technology systems: A conceptual framework. *Available at*: https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/distributed-ledger-technology-systems/#.XkwjwihKj-h

Rauchs, M., Blandin, A., Bear, K., & McKeon, S. B. (2019). 2nd Global Enterprise blockchain benchmarking study. Available at SSRN 3461765. *Available at:* https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/2nd-global-enterprise-blockchain-benchmarking-study/

Rikhardsson, P., & Yigitbasioglu, O. (2018). Business intelligence & analytics in management accounting research: Status and future focus. *International Journal of Accounting Information Systems*, *29*, 37-58.

Risius, M., & Spohrer, K. (2017). A blockchain research framework. *Business & Information Systems Engineering*, *59*(6), 385-409.

Scapens, R. W., & Jazayeri, M. (2003). ERP systems and management accounting change: opportunities or impacts? A research note. *European accounting review*, *12*(1), 201-233.

Schloetzer, J. D. (2012). Process integration and information sharing in supply chains. *The Accounting Review*, *87*(3), 1005-1032.

Simons, R. (1994). *Levers of control: How managers use innovative control systems to drive strategic renewal*. Harvard Business Press.

Swan, M. (2018). Blockchain for business: Next-generation enterprise artificial intelligence systems. In *Advances in computers* (Vol. 111, pp. 121-162). Elsevier.

Swanson, T. (2015). Consensus-as-a-service: a brief report on the emergence of permissioned, distributed ledger systems. *Available at:* https://allquantor.at/blockchainbib/pdf/swanson2015consensus.pdf

Szabo, N. (1997). Formalizing and securing relationships on public networks. *First monday*.

Tasca, P., & Tessone, C. J. (2017). Taxonomy of blockchain technologies. Principles of identification and classification. *Available at:* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2977811

The Economist. (2015a). The next big thing. *Available at* http://www.economist.com/news/special-report/21650295-or-it-next-big-thing

The Economist. (2015b). The trust machine. *Available at* http://www.economist.com/news/leaders/21677198-technology-behind-bitcoin-could-transform-how-economy-works-trust-machine

Tomkins, C. (2001). Interdependencies, trust and information in relationships, alliances and networks. *Accounting, organizations and society*, *26*(2), 161-191.

Van Hoek, R. and Lacity, M. (2020). How the Pandemic Is Pushing Blockchain Forward. *Harvard Business Review*, Available at: https://hbr.org/2020/04/how-the-pandemic-is-pushing-blockchain-forward

Vosselman, E., & Van der Meer-Kooistra, J. (2009). Accounting for control and trust building in interfirm transactional relationships. *Accounting, Organizations and Society*, *34*(2), 267-283.

Wang, H., Chen, K., & Xu, D. (2016). A maturity model for blockchain adoption. *Financial Innovation*, *2*(1), 1-5.

Williamson, O. E. (1983). Credible commitments: Using hostages to support exchange. *The American Economic Review*, *73*(4), 519-540.

Williamson, O.E. (1985). The economic institutions of capitalism. *The Free Press*, New York.

Wörner, D., Von Bomhard, T., Schreier, Y. P., & Bilgeri, D. (2016). The bitcoin ecosystem: Disruption beyond financial services?. *Available at:* *https://www.alexandria.unisg.ch/248647/1/2201_ECIS_Bitcoin_Ecosystem_Final.pdf*

Xu, X., Weber, I., Staples, M., Zhu, L., Bosch, J., Bass, L., Pautasso, C., & Rimba, P. (2017, April). A taxonomy of blockchain-based systems for architecture design. *In 2017 IEEE international conference on software architecture (ICSA)* (pp. 243-252). IEEE. Available at: https://ieeexplore.ieee.org/document/7930224

Yermack, D. (2017). Corporate governance and blockchains. *Review of Finance*, *21*(1), 7-31.

Yin, R. K. (2009). *Case study research: Design and methods* (5th ed.). Thousand Oaks, CA: SAGE.

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.

Zhao, K., & Xia, M. (2014). Forming interoperability through interorganizational systems standards. *Journal of Management Information Systems, 3*0(4), 269-298.

Chapter 2: Paper 1: Blockchain technology, inter-organizational relationships and management accounting: A synthesis and research agenda

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ABSTRACT

Blockchain technology is increasingly emerging as an important organizational phenomenon, especially for collaboration across firm boundaries. Over the past three decades, accounting scholars have shown significant interest in management accounting and control mechanisms that are used by actors to sustain the inter-organizational relationship (IOR). We outline fundamental technical features and limitations of permissioned blockchain technology and analytically propose it as an empirical concept with implications for management accounting practices that underpin inter-organizational collaboration, trust, control, and information exchange. Particular focus of the analysis is on the interplay between the technical capabilities of blockchain technology and inter-organizational management control procedures. Based on this analysis, we develop a series of propositions that theorize how these procedures affect the way in which blockchain is enacted in IORs, and how they are affected by blockchain in turn. The paper concludes with a research agenda for accounting scholars and offers directions for further research.

Keywords: Blockchain; management accounting; inter-organizational relationships; management control; information systems; collaboration.

1. Introduction

The motivation behind this paper stems from the rise to prominence of an innovative and arguably organizationally disruptive distributed database technology, colloquially referred to as blockchain, and its potential in inter-organizational relationships (IORs). In the IOR literature it is generally understood that legally autonomous partnering firms essentially play a "mixed motive game", which entails a mixture of mutual dependence and conflict, of partnership and competition (Schelling, 1960). In other words, IOR partners have overlapping (to a greater or a lesser extent), but ultimately separate profit motives (Anderson et al., 2014). Based on its core attributes, which allow legally independent parties that may or may not fully trust each other to conduct and reliably control mutual interactions without reliance on a single controlling entity (Risius and Sproher, 2017), blockchain technology seems highly suitable for IORs, where a mix of private and common goals is inherently present (Castañer and Oliveira, 2020). Against this backdrop, we conceptualize blockchain technology as an inter-organizational information infrastructure and analyze its potential and ramifications in IOR settings, with a specific focus on the governance and management control implications. IORs can be defined as voluntarily initiated collaborative arrangements between legally independent firms that can involve information exchange, sharing or co-development of products and services, and can include partner contributions of technology, capital, or firm-specific assets (Gulati and Singh, 1998). More specifically, in our analysis we focus on formal, purposeful, non-equity-based contractual IORs resulting from negotiations between organizations that remain legally independent in the access to, exchange, and/or joint generation of resources (Caglio and Ditillo, 2008; Castañer and Oliveira, 2020). This definition refers to IOR forms involving transactional types of interactions between IOR partners (e.g. strategic alliances, supply chain relationships, networks, coalitions, industry consortia, outsourcing agreements), and excludes those where at least one of the negotiating organizations ceases to operate as a distinct legal entity as a result of those negotiations (e.g. mergers and acquisitions) (Castañer and Oliveira, 2020).

The concept of a "transaction" is understood here as occuring "when a good or service is transferred across a technologically separable interface" (Williamson, 1985, p.1). Organizing transactions between firms involves significant control challenges that have been the topic of extensive research by management accounting scholars (e.g. Baiman and Rajan, 2002; Dekker, 2004; Reusen and Stouthuysen, 2020). This topic is particularly salient in inter-firm interactions involving blockchain, since the technology allows for multi-lateral collaborative arrangements that can encompass multiple traditional IOR forms. An example of a blockchain project can include a strategic alliance between an IT vendor and a client, through which a solution is developed that is, in turn, partly governed through a consortium that includes the client's industry rivals. The solution is used to foster interactions between traditional supply chain partners, but also independent bodies such as authorities and regulators from different countries (Jensen et al., 2019; Zavolokina et al., 2020).

To focus the analysis, we outline four main areas within the IOR literature, which appear to be the most relevant to investigate in relation to blockchain technology, namely collaboration, trust, inter-organizational control, and information exchange. We analyze literatures within each of these areas with a focus on management control issues, identify recurring and pertinent themes, and consider how each could be impacted by blockchain technology. Based on this discussion, we develop several propositions that constitute a research agenda intended to serve as a guide for future research within the identified areas.

Our paper makes several contributions. Firstly, we contribute to the accounting literature on management control in inter-firm settings. We analytically specify blockchain as an inter-organizational information infrastructure and propose it as an empirical concept with implications for transaction hazards (Williamson, 1985) and the corresponding formal and informal management control remedies in IOR settings, namely trust, partner selection, and contracting (e.g. Dekker, 2004; 2008; Ding et al., 2013; Anderson et al., 2017). In doing so, we discuss the interplay between the technical capabilites, operational realities and limitations of blockchain technology, and inter-firm management control procedures that both impact how blockchain is enacted in IORs, and are themselves impacted by blockchain. In discussing technical capabilities of blockchain technology, we focus on permissioned blockchains and emphasize tamper evidence and reliability of records, multi-party consensus and automatic execution of agreements codified in smart contracts as technological attributes salient for IORs. Accordingly, we discuss their limitations. Going further, we discuss governance choices in IORs in the presence of blockchain, namely partner selection, specification of information exchange procedures and the determination of the nature and scope of the collaboration between partners. Moreover, we analyze the effects of blockchain on inter-firm controls and provide novel insights on the multi-lateral effects of blockchain on trust between IOR partners, and the design and implementation of inter-firm contracts.

Secondly, we analyze different strands of accounting literature that often explore management control issues separately, and supplement the analysis with contributions from organizational and information systems studies on the origins, nature and dynamics of inter-firm collaboration, as well as issues regarding inter-firm information exchange. We then synthesize the arguments in a theoretically consistent manner in the form of a series of propositions. By integrating arguments on IORs and blockchain from several fields of research, we offer novel insights on two complex technological and organizational phenomena, and take a step towards providing a more holistic analysis of the management control implications of blockchain technology in IORs.

Thirdly, we contribute to the growing literature examining blockchain technology as an organizational phenomenon (e.g. Beck et al., 2018; Murray et al., 2019; Kumar et al., 2020; Lumineau et al., 2020). We explicitly focus on permissioned blockchains and provide a detailed discussion of their technical capabilities and limitations in the context of inter-firm transacting. Thereby, we provide conceptual clarity and address several common misconceptions (e.g. regarding "immutability" of the blockchain ledger, automatic enforcement of smart contracts and the issue of data endo/exogeneity) found in the literature. In other words, the paper contributes to advancing our understanding of what blockchains can and cannot do in an IOR context, theorizes on the management control implications of its use, outlining an agenda for future research on blockchain in management accounting in the process.

The remainder of the paper is structured as follows. First, we discuss blockchain as an inter-organizational and management accounting phenomenon, and identify a research gap to be addressed in this paper. Second, we outline a guiding framework based on a review of IOR literature in management accounting and related fields. Third, we conceptualize blockchain technology, identify its different characteristics, and the design considerations relevant for entities that seek to implement it. Fourth, we discuss implications of blockchain technology for different types of transactions between firms. Fifth, we return to the guiding framework, we identify and discuss the most prevalent issues within each of the proposed fields, which are the most likely to be affected by the use of blockchain technology. Sixth, based on this discussion, and blockchain capabilities, we develop a number of propositions and present a research agenda, which could be a useful guide for future studies in this area. Finally, we conclude with a summary of proposed arguments and provide suggestions for further research.

2. Blockchain as an inter-organizational phenomenon

The first successful use case for blockchain technology was Bitcoin, a digital currency based on a peer-to-peer network and cryptographic tools (Nakamoto, 2008). The Bitcoin blockchain allows its users to exchange non-duplicable digital tokens carrying monetary value in an environment consisting of disparate pseudonymous[10] actors, which is assumed to be inherently adversarial.[11] In an IOR setting, blockchain technology allows partners to transfer digital assets or business-relevant information (e.g. about orders, receipts, payments, etc.) across firm boundaries through a shared, tamper-resistant distributed ledger (Kumar et al., 2020). In other words, blockchain technology enables multiple independent parties to jointly generate, maintain, and update a shared set of authoritative records; facilitates decentralized management of information and digital assets; supports algorithmic enforcement of shared agreements in the form of smart contracts; and verifies the ordering of data records in a potentially adversarial environment (Rauchs et al., 2018b). This is achieved without reliance on centralized[12] trusted authorities like governments, banks or payment services to serve as guarantors of the correctness of records or facilitators of transactions between parties. When conceptualizing blockchain technology, many authors focus on describing a decentralized, public permissionless blockchain, such as Bitcoin's blockchain. Some additionally categorize blockchains as permissioned and permissionless (e.g. O'Leary, 2017). Full accessibility of ledger data, as well as pseudonymity of users inherent to permissionless public blockchains is undesirable (or even illegal) in many business settings, and especially in an IOR context as defined here. In contrast, permissioned blockchains are used in business networks of known, vetted participants (Carvalho, 2020). Establishing and maintaining such networks can be fraught with management control issues, which have been extensively discussed in the IOR literature. Therefore, in the remainder of this paper we will focus our analysis on permissioned blockchains and their implications for management control issues in IORs. More generic terms, namely "blockchain technology" or "blockchain" will be used instead for ease of exposition.

Financial records have traditionally been maintained by individual entities in a centralized

[10] Every Bitcoin user is tied to a specific alphanumeric address, and can choose to remain anonymous or reveal their identity to others.

[11] For an in-depth technical overview see: Narayanan, Bonneau, Felten, Miller and Goldfeder (2016).

[12] A certain level of centralization can be introduced to a given blockchain system, contingent on specific design choices (discussed in more detail below).

manner, exhibiting an orientation to accounting practices that Hopwood (1996) described as being hierarchical in nature. Blockchain on the other hand offers a radically different (i.e. distributed) alternative for recording transactions in a multi-party setting. According to some authors (e.g. Abadi and Brunnermeier, 2018), this could revolutionize recordkeeping of financial transactions and ownership of data. More specifically, in contrast to traditional centralized ways of organizing inter-firm transacting, where information is stored in isolated "silos" or controlled by a centrally positioned entity, a blockchain system requires that multiple parties review, verify, and ultimately accept or reject proposed transactions (i.e. reach a consensus in a decentralized manner). Furthermore, due to its ability to implement atomic transactions[13], build a tamper-resistant audit trail, and simplify settlement and reconciliation across organizations, blockchain has seen fast experimentation and adoption particularly within the areas of supply chain management, finance, and accounting, not least because the combination of the aforementioned characteristics of the technology promote higher data integrity (Catalini and Gans, 2016; Coyne and McMickle, 2017). Beyond the cryptocurrency space, blockchain technology has attracted interest of many established firms that have become involved in trials and proofs of concept, or have major commercial projects already in production. Examples include but are not limited to logistics and supply chain companies (Jensen et al., 2019), pharmaceutical firms (Mattke et al., 2019), car industry actors (Zavolokina et al., 2020), banks (e.g. JPMorgan Chase[14]), accounting firms and consultancies (e.g. Deloitte[15], EY[16]), and retailers (e.g. Walmart[17]) (Lacity, 2018). Each of these projects brings together tens, or even hundreds of heterogeneous partners, which work collaboratively on the development and deployment of different blockchain-based solutions for their inter-organizational environments. While for many firms blockchain technology is unquestionably still in the experimental phase of development, and surrounded by technological, economic, and operational uncertainties, the developments listed above, as well as several recent studies (e.g. Cong and He, 2019; Kumar et al., 2020; Lumineau et al., 2020) suggest that it is emerging as an economically significant technology with salient real-world business implications.

[13] Catalini and Gans (2016) define atomic transactions as those that can be fully executed and enforced through a distributed ledger, and whose key attributes can be verified through the same ledger without interference of a third party intermediary (i.e. transactions containing blockchain endogenous data only).
[14] For more details see: https://www.jpmorgan.com/global/technology/blockchain
[15] For more details see: https://www2.deloitte.com/content/dam/insights/us/articles/2019-global-blockchain-survey/DI_2019-global-blockchain-survey.pdf
[16] For more details see: https://www.ey.com/en_gl/blockchain
[17] For more details see: https://cointelegraph.com/news/walmarts-foray-into-blockchain-how-is-the-technology-used

The examples listed above speak to the fact that blockchain is by design a multi user technology. It is intended for continuous, non-centrally governed interaction among heterogeneous groups of participants. Moreover, it supports independent development and deployment of autonomous, collaborative, and highly interoperable services by users of the system (Glaser, 2017). "Smart contracts" represent an example of such services. Smart contracts are defined here as automatically executable agreements between parties based on pre-defined codified criteria (Halaburda et al., 2019). Wide implementation of smart contracts will have important ramifications for organizational theory and practice, since their use could significantly influence the level of frictions, costs, and control mechanisms in transactions between firms. Core functionalities of smart contracts fundamentally represent a routinisation of certain pre-determined processes, which reduces those processes to a set of articulated conditions, monitoring of those conditions, and execution based on those conditions (Murray et al., 2019). An important corollary of automatic execution of digital contracts in an IOR context is the elimination of the possibility of renegotiation of the encoded contractual terms (Halaburda et al., 2019). Put succintly, the use of blockchain technology and smart contracts could have a notable effect on transaction costs and, in turn, firm boundaries and the nature of inter-firm governance. These issues are most commonly discussed in the management accounting literature, particularly in the area related to management control in IORs. Contemporary accounting studies, however, mostly explore the use of blockchain technology within the context of financial accounting. Perhaps because of the intuitive link between the concept of a blockchain ledger and accounting ledgers, some considered the possibility of blockchain technology becoming a more secure, immutable alternative to current ledger database solutions (Coyne and McMickle, 2017). Most frequently discussed benefits are increased speed and reduced costs of maintaining and reconciling ledgers (Dai and Vasarhelyi, 2017), real-time accounting (Yermack, 2017), increased security and control (Peters and Panayi, 2016) and automation of accounting and auditing rules that could be programmed onto the blockchain. Dai and Vasarhelyi (2017) further argue that blockchain could facilitate "triple-entry accounting" by acting as a neutral "intermediary" that would enhance the reliability of firms' financial statements. The authors suggest that each account in a contemporary double-entry booking system could have a corresponding blockchain account. At the same time, the field of management accounting in general, and the area relating to management control issues in IORs in particular, at present remains largely underexplored regarding blockchain, its possible uses, and their implications. Therein lies a research gap that we attempt to address in this paper.

2.1. Blockchain and management accounting

Accounting and management studies of IORs (e.g. Håkansson and Lind, 2004; Kajüter and Kulmala, 2005; Anderson et al., 2014; Grafton and Mundy, 2017; Litwak and Hylton, 1962) find that a situation of partial conflict exists between partners even when collaboration comes with unambiguous and observable advantages and strong incentives for partners to establish and maintain the partnership. Moreover, some forms of IORs (e.g. supply-chain relationships, networks, strategic alliances, outsourcing agreements) represent organizational arrangements which exist in conditions of somewhat unstructured authority. Collaboration between partners is necessary to preserve these organizational forms, yet it is often the case that no single entity involved in the relationship possesses sufficient formal authority to be able to impose collaboration through fiat (Litwak and Hylton, 1962).

Research in accounting and economics (e.g. Baiman and Rajan, 2002; Williamson, 1993; Dekker, 2004; Clemons and Hitt, 2004) discusses opportunism and coordination as notable management control issues with implications for IOR theory and practice. The concept of "opportunism" itself has been defined as self-interest seeking with guile, and it more generally refers to the deliberate incomplete or distorted disclosure of information between partners (Williamson, 1985). Examples of opportunism discussed in the literature include ex ante behavior such as deliberate misrepresentation of a firm's true attributes prior to the signing of a contract, termed "pre-contract hidden information" (Arrow, 1985), misappropriation of information by the recipient that cannot be legally prevented, and benefits from which cannot be contracted on (Clemons and Hitt, 2004; Baiman and Rajan, 2002). The examples also include ex post shirking on quality, effort or information provision (Baiman and Rajan, 2002). These can create transaction hazards (Williamson, 1985; Dekker, 2004; Reusen and Stouthuysen, 2020) and tension between partners, which necessitates that different formal and/or informal safeguards and control mechanisms be put in place to mitigate those hazards and manage the IOR. In addition, managing transaction risks, including opportunism, represents only a part of the control challenges faced by IOR partners (Dekker, 2004). Firms establish IORs with the aim of realizing mutually beneficial outcomes by perforing value-creating activities in a cooperative manner (Dyer and Singh, 1998; Zajac and Olsen, 1993). To create transactional value, IOR partners pool resources, determine tasks to be performed, and decide on the division of labor (Dekker, 2004). This results in interdependence between the agreed-upon sub-tasks to be performed by partners. As a corollary, these need to be coordinated across organizational boundaries. Coordination of interdependent tasks between partners has therefore been broadly recognized as a second important management control issue in IORs (Thompson, 1967; Gulati and Singh, 1998; Dekker, 2004). In sum, a growing strand of literature primarily in management accounting but also several related disciplines concerning IORs proves helpful in articulating and addressing our research aims. A guiding framework including the major themes in these literatures has been developed to facilitate the analysis.

3. Guiding framework

Given that the body of literature on IORs has become quite large and diverse, we find it useful to narrow our focus to particular areas, which might be impacted by blockchain technology. The analysis uncovers four main areas that are seen as the most relevant to explore in this regard. These areas are presented in figure 1. It is important to note that these topics do not exist in isolation, but are strongly interrelated, and considerable overlap between the relevant theoretical concepts was found in the literature.

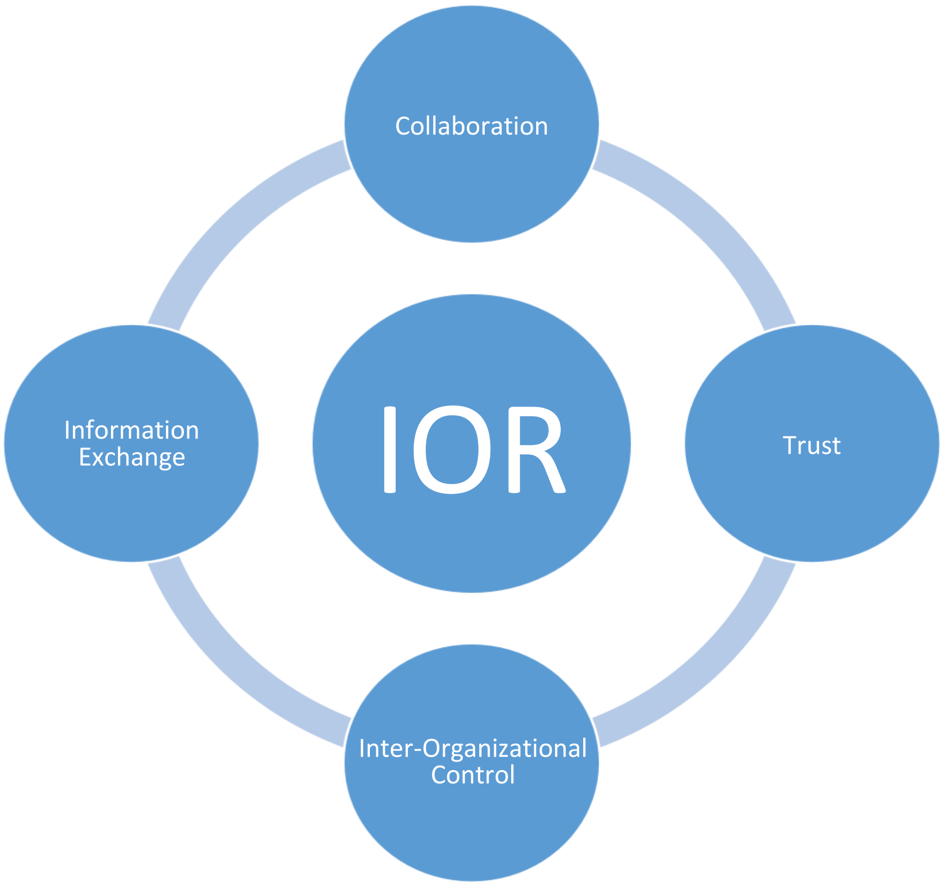

Figure 1: Areas identified in the literature on inter-organizational relationships, which are likely to be impacted by blockchain technology.

Collaboration is the first area identified within the literature on IORs. Since blockchain technology is, by design, a multi-party system (Glaser, 2017), some level of collaboration between partners will be necessary both during the process of design and implementation of a blockchain solution, as well as during its operational phase. When setting up a common IT infrastructure, based on blockchain, the implementing partners will likely need to identify the potential future benefits and clarify expectations for the relationship ex ante. Following from this, two related areas, or "facets of collaboration" (Gulati et al., 2012), emerged within this broader area, namely cooperation and coordination. Blockchain is often described as a "trust-less" technology (e.g. Xu et al., 2017), able to replace trust in an intermediary with trust in inherent consensus rules and underlying code (Catalini and Gans, 2016). This may not be the case to the same extent with permissioned blockchains, where a "gatekeeper" grants participants access to the system (Rauchs et al., 2018b). Consequently, some level of familiarity and ex ante trust needs to be established between partners. This makes the concept of trust (e.g. Luhman, 1979; Rousseau et al., 1998) critical to explore in our context, and was identified as the second area of the framework. As it establishes a distributed tamper-evident audit trail between firms, among other characteristics that are discussed in more detail below, blockchain could serve as a powerful complement and enabler of management control mechanisms in IORs. Hence, inter-organizational control was identified as the third high-level area that may be impacted by the technology. Since implementations of blockchain technology will inevitably involve creating a network of partners, the literatures on partner selection (e.g. Dekker, 2008; Neumann, 2010; Dekker and Van den Abbeele, 2010), and contracting (e.g. Anderson and Dekker, 2005; Poppo and Zenger, 2002; Reuer and Ariño, 2007; Ding et al., 2013) are particularly informative sub-areas to explore. Finally, given that the primary reason for companies to implement blockchain technology may be the desire for a trustworthy and reliable exchange of information, information exchange is the fourth area discussed in this review.

4. Conceptualizing blockchain

4.1 Blockchain characteristics

The most commonly identified characteristics of blockchain technology are peer-to-peer (P2P) transmission, shared recordkeeping, multi-party consensus, independent validation, tamper resistance, tamper evidence, and transparency (e.g. Rauchs et al., 2019). Blockchain functionalities are akin to a distributed ledger that is collectively kept, updated, and validated by the parties within a network (Risius and Spohrer, 2017). Rauchs et al. (2018b, p.24) define it as "*[…] a system of electronic records that enables a network of independent participants to establish a consensus around the authoritative ordering of cryptographically-validated ("signed") transactions. These records are made persistent by replicating the data across multiple nodes, and tamper-evident by linking them through cryptographic hashes. The shared result of the reconciliation/consensus process—the 'ledger'—serves as the authoritative version for these records*". These features have prompted some authors (e.g. O'Leary, 2017) to describe the blockchain as "immutable" and therefore reliably secure. However, the notion of immutability might not be entirely correct. Different incarnations of blockchains provide different levels of transaction finality, contingent on the design of the system. Therefore, it might be more accurate to describe a blockchain ledger as "tamper-resistant" and "tamper-evident", as its architecture allows network participants to detect non-consensual, trivially-applied changes to the records (Rauchs et al., 2018b), reliably observe and analyze them, and therefore be more confident in uncovering instances of fraudulent behavior (Szabo, 2017).

Blockchain systems allow for new ways of decentralization and delegation of services that are enacted through autonomous interacting pieces of code, often referred to as smart contracts (Glaser, 2017). Several authors (e.g. Risius and Spohrer, 2017) have observed that smart contracts can allow parties that do not completely trust each other to handle and control mutual transactions without needing to depend on any trusted intermediary. Conversely, others (e.g. Gans, 2019; Rauchs et al., 2018b; Xu et al., 2017) comment that such contracts are not strictly speaking fully autonomous and adaptive, nor do they at the moment necessarily represent a legal agreement in most jurisdictions, and especially across jurisdictions. While the parties may have an underlying contract that is legally binding, the smart contract represents the code for the contract's execution. In other words, a smart contract is a means by which obligations can be recorded, triggering other obligations that can be set up to operate in an automated way (Gans, 2019). It is worth noting here that these attributes are fully applicable when the data they are connected to (i.e. input and output) are endogenous to the blockchain system (i.e. exist only within its boundaries). This is because a fundamental requirement for smart contracts to be functional and cost-efficient is the ability to produce “hard evidence” of (non) performance on an obligation. In the former situation, the necessary evidence may be hard coded, however in the latter situation where contractual obligations rely on evidence to be provided from outside of the purely digital realm, a blockchain system (and the corresponding smart contract) needs to create incentives and control mechanisms for disclosure of accurate information about contract performance (Gans, 2019).

4.2. Blockchain design considerations

The design process of a blockchain system comes with inherent trade-offs, as specific functionalities of the technology inevitably come at the expense of others (Rauchs et al., 2018b). We analyze design considerations for the dimensions most critical when considering blockchain technology in the context of IORs, namely decentralization, consensus protocols, and exogenous and endogenous data references.

The level of de/centralization is a continuous variable emerging from the interaction of system components, hierarchies, and power structures. Therefore, the concepts of “centralization” and “decentralization” must be seen as falling along a continuum, rather than being binary (Rauchs et al., 2018b). A recurring theme across different definitions of “decentralization” is determining whether the system allows open and free participation, as opposed to entrusting system management and decision making to a dominant entity (Coyne and McMickle, 2017; Rauchs et al., 2018b; Xu et al., 2017). Public, permissionless blockchains such as Bitcoin’s aim for full decentralization in order to attain censorship resistance (Rauchs et al., 2018b). Permissioned blockchain designs on the other hand prioritize shared recordkeeping, multi-party consensus, independent validation, tamper evidence, tamper resistance and validation speed, while limiting participation to a group of vetted participants that may or may not be fixed. In the context of de/centralization, such blockchains can be best described as “federated business networks” (Rauchs et al., 2019). They distribute control among participants so as to not allow for overall network governance to be dominated by a single entity. However, in practice this distribution is often less than equal, as a greater level of control resides with certain participants, while the ability to write or read particular data could be limited to a specific group of approved nodes.

Choosing an appropriate consensus protocol is another important design decision. The records on a blockchain are subject to network consensus, meaning that they must adhere to the rules of a protocol. Swanson (2015) describes network consensus as "*the process in which a majority (or in some cases all) of network validators come to an agreement on the state of a ledger. It is a set of rules and procedures that allows maintaining a coherent set of facts between multiple participating nodes*" (p. 4). In permissioned blockchains, consensus is reached through several producers of records who have been authorized and/or obligated by a contract or some other kind of an agreement to assume this role (Rauchs et al., 2018b). This incurs additional design tradeoffs, but can positively affect the reliability of the system if the system consists of actors that have engaged in prior interactions or otherwise share a certain level of trust ex ante. It also necessitates that the implicit agreement over the very nature (i.e. basic characteristics) of the system be reached among the stakeholders in the wider ecosystem. Any party involved in the sytem—whether directly or indirectly—potentially partakes in this agreement, although the level of influence over the process can vary widely (Rauchs et al., 2019).

The final core design consideration in a blockchain network pertains to the nature of data that is exchanged between participants (i.e. "endogenous data" and/or "exogenous data"). Endogenous data refers to the information that comes exclusively from within the core blockchain system. Exogenous data refers to data that tracks information about the same entity or a relationship that is external to the blockchain system (Rauchs et al., 2018b). Blockchain only has fully effective enforcement capabilities (i.e. the ability to automatically execute decisions) with regards to endogenous data (i.e. internal references that exclusively exist within the boundaries of the system). The states of external systems are not directly accessible by the blockchain system (Xu et al., 2017), which means that interfacing with an external source of data requires a gateway and additional protocols. This often necessitates that the notion of IORs and some level of traditional management controls be considered and possibly introduced (Szabo 2017).

5. Blockchain and different types of inter-firm transactions

In order to obtain a more nuanced understanding of the applicability of blockchain in IORs it is necessary for the analysis to go beyond its strictly technical attributes and consider the interplay between these attributes and the nature of transactions that can occur between IOR partners. The successful execution of a transaction is based on critical information about responsibilities, procedures, and objectives of the parties involved, attributes that can be quite explicit for some, but also higly tacit for other transactions (Lumineau et al., 2020).

Drawing mainly on studies in transaction cost economics (TCE) (e.g. Nooteboom, 1992), Lumineau et al. (2020) build on the notion of "tacitness" in transactions as a function of the transaction's level of *codifiability* and *verifiability*. On a fundamental level, tacitness is defined as difficulty in conveying information, while in the context of a transaction it refers to the difficulty of codifying key transaction attributes (Kogut and Zander, 1992) or complications in encoding key transaction attributes such as responsibilities, procedures, and objectives (Lumineau et al., 2020). More generally, codifiability is here referred to as the ability to precisely characterize product/service, delivery, and settlement requirements in an electronic format, and in a manner understandable to relevant parties (Lumineau et al., 2020). On the other hand, verifiability signifies the extent to which transacting parties are able to observe and evaluate the quality of an item of exchange or adherence to specified requirements ex post (Dulleck et al., 2011). Verifiability is highest for search goods, and lowest for credence goods (Nelson, 1970; Lumineau et al., 2020). To this we add the concept of *standardization*, as a multi-level construct salient in various contexts including inter-partner transacting *within* an IOR (e.g. Steinfield et al., 2011) or *across* different industry sectors (e.g. Markus et al., 2006). The issue of standardization in a broader blockchain context also refers to "linking the chains" (Kumar et al. 2020), in other words interoperability, as different partners from a single IOR may join different blockchain platforms, which then must be sufficiently integrated to be effective and economically viable.

The issues of codifiability, verifiability and standardization of transactions are of great importance when considering the applicability of blockchain technology in IORs, not least because automatic execution of codified agreements on a blockchain requires that the recorded transactions are highly verifiable and that transaction requirements are liable to be easily and reliably standardized and formalized in computer code. Referring back to the technical properties of data endo/exogeniety in blockchains, the issue with automatic execution based on data that is exogenous to the blockchain system proper has been referred to by different authors as the oracle problem (Murray et al., 2019) or the gateway problem (Halaburda, 2018). The gateway problem generally describes potentially adverse consequences of automatic execution based on erroneous data that is fed into the blockchain system, as well as the need to include verifiers to ensure the reliability of the data that could arise as a result of using exogenous data references (Xu et al., 2017). While this is undobtedly a drawback of using blockchain technology in an IOR setting where many data references are exogenous, the gateway problem is not impossible to address, nor are all types of transactions equally susceptible to it. In a permissioned blockchain environment consisting of vetted participants several management control mechanisms including trust (Halaburda, 2018) that will be discussed in detail below can be used to reduce transaction hazards and thus address the gateway problem. In other words, benefits stemming from blockchain's distributed data management and consensus mechanisms, as well as automated execution through smart contracts are viable primarily for inter-firm transactions that can be handled exclusively through blockchain (i.e. endogenously), but also for others (i.e. highly standardized, verifiable and codifiable), as those can be reliably referenced on the blockchain even though the original data sources are exogeneous to it. Furthermore, it is important to note that in explicit transactions for which specific plans can be devised ex ante, and which do not require high levels of flexibility (e.g. procurement of standardized materials from an alliance partner) the gateway problem of blockchains represents less of an organizational challenge, and the benefits of using a blockchain could outweigh the associated risks (Lumineau et al., 2020). At the same time, the benefits of relying solely on blockchain in tacit transactions that include complex interdependent activities requiring the ability for the partners to adapt to unforseen events are less than clear primarily because of the standardization, codification and verification challenges involved in these transactions.

6. A closer look into the framework

6.1. Inter-organizational relationships

Collaborative arrangements between legally autonomous parties that do not readily fit the "market-hierarchy" dichotomy (e.g. Coase, 1937; Williamson, 1985) have become central to economic activity (e.g. Salvato et al., 2017; Anderson and Dekker 2014). Consequently, they have sparked research interest and have been recognized as a distinct kind of organizing, called "hybrids" (Williamson 1985, 1991). In this context, in line with Ménard (1995), we define an "organization" as an arrangement designed to make possible the conscious and deliberate coordination of activities within identifiable boundaries. In organizations, its members associate on a regular basis through a set of implicit and explicit agreements, and commit to collective actions for the purpose of creating and allocating resources and capabilities by a combination of command and cooperation (Ménard, 1995). The "hybrid" arrangements between organizations can take a variety of forms (e.g. strategic alliances, supply chain relationships, networks, coalitions, industry consortia, outsourcing agreements), and have been referred to as "inter-organizational relationships", "inter-firm settings", "hybrid organizational forms", and "networks" (Anderson and Sedatole, 2003; Caglio and Ditillo, 2008). In this paper we adopt inter-organizational relationships (IORs) as a universal term.

Unlike inter-organizational arrangements backed by extensive contracts such as franchise agreements, IORs that are in the focus of this study do not rely solely, or sometimes even primarily, on extensive contracts to achieve control or coordination (Anderson et al., 2017). Given incomplete contracts (Baiman and Rajan, 2002) and the resulting inability to fully rely on external legal enforcement mechanisms to sustain IORs, management accounting scholars have focused instead on changing circumstances within firms to explain the sustainability of IORs (Anderson and Dekker, 2014). Inter-organizational controls, in their form and variety, bear a greater resemblance to management controls used within firms (e.g. Anthony, 1965; Merchant and Van der Stede, 2017) than to extensive contracts that exemplify franchise agreements (Anderson and Dekker, 2014). The incomplete contracts typifying IORs, and the associated residual risks that might preclude inter-firm transacting, are made sustainable through the use of management control mechanisms such as improved measurement of actions and outcomes, and joint collaborative practices that enhance information sharing across firm boundaries and opportunities for formal and informal monitoring (Anderson et al., 2017a; Dekker, 2004; Ding et al., 2013). It is in this space, termed "inter-organizational control", that management accounting studies have made notable contributions to understanding the nature of IORs as a modern, interconnected organizational form (Anderson and Dekker, 2014). Understood in this way, IORs do not represent mere deals and strategic agreements, but are also entities characterized by information-sharing and decision-making processes, boundary spanning individuals, boards and committees, databases and integrated computer systems, as well as other material and immaterial resources, all of which entail practical organizational challenges (Gulati et al., 2012). Such relationships enable organizations to gain access to technologies, competencies, and economies of scale and scope of trading partners in more efficient ways than is in many cases possible through arm's-length transactions (i.e. market), or vertical integration (i.e. hierarchy) (Coad and Cullen, 2006).

Utilization of new information systems and production arrangements that increase the interdependence or organizational tasks has resulted in the need to provide local managers with information relevant for ensuring effective integration and coordination (Hopwood, 1996). In IORs, where management control processes transcend legal organizational boundaries, this has resulted in frequent exchange of lateral information (Hopwood, 1996; Anderson and Dekker, 2014). Consequently, management accounting studies have identified "information openness" as an important theme related to the functioning of different forms of IORs such as supply chain relationships (e.g. Baiman and Rajan, 2002; Caglio and Ditillo, 2012; Schloetzer, 2012; Reusen and Stouthuysen, 2020), networks (e.g. Kajüter and Kulmala, 2005; Håkansson and Lind, 2004), and alliances (e.g. Nicolaou et al., 2011; Christ and Nicolaou, 2016). In these studies, transfers of information of varying types have been shown to work well even without vertical integration between partners. Moreover, Christ and Nicolaou (2016) find greater collaboration intensity[18] to be associated with greater information system integration as well as the implementation of a larger portfolio of controls between partners in an alliance[19], making the establishment of a common information infrastructure a salient issue in an IOR context. Common information infrastructure is here seen as the "blueprint" for the interaction patterns through which collaborating firms share the risks and govern the partnership (Christ and Nicolau, 2016). Simultaneously, the collaborative environment that spans organizational borders presents management control challenges for the firms involved (Coletti et al., 2005). Not least because the terms of incomplete contracts between IOR partners often rely upon accounting data and refence the use of management controls aimed at aligning partner incentives or coordinating their actions (Anderson and Dekker, 2014). In an IOR setting, the coordination and control of the common activities cannot be completely handled internally, nor can this be achieved by market forces alone. The reason is that these activities, even when they are complementary, need to be performed by legally independent entities, which means that the partners' plans need to be aligned (Håkansson and Lind, 2004).

In the remainder of this section, we return to the guiding framework outlined above, and review literatures in each of the four identified areas, namely collaboration, trust, inter-organizational control, and information exchange. The ensuing discussion in which we identify and scrutinize

[18] Christ and Nicolaou (2016) describe collaboration intensity as referring to the importance of multiple alliance objectives to a firm.

[19] The authors use "alliance" as an aggregate term to connote inter-organizational relationships ranging from joint ventures to strategic partnerships and supply chain relationships.

major topics examined in these literatures is additionally informed by our preceding analysis of blockchain technology. The explicit goal of this discussion is to synthesize the existing knowledge about these concepts, focusing on the implications of blockchain technology for each of the four main areas of the framework. Major arguments resulting from the discussion are distilled into several propositions, which are intended to serve as building blocks of a research agenda, a prolegomena of sorts, for future efforts in blockchain-related management accounting research. It is our contention that this research agenda could help to equip accounting scholars with "instruments" to critically study IORs as an important organizational form as it increasingly becomes interrelated with an emerging technological phenomenon that is blockchain.

6.2. Collaboration

Studies of IORs have found inter-firm collaboration to be an important source of competitive advantage for many companies, because it enables value creation through accessing and combining complementary resources and capabilities from partnering firms (Dyer and Singh, 1998; Coletti et al., 2005). At the same time, inter-firm collaboration can be very risky and complex (e.g. Gulati et al. 2012). It necessitates that relationship partners are capable of communicating, developing and maintaining an inter-organizational interface, and internally adapting in response to relationship partners' actions or the changing external environment (White, 2005). Cooperation and coordination have been identified in the IOR literature as two distinct yet complementary facets of inter-firm collaboration (e.g. Salvato et al., 2017; Gulati et al., 2012). Here, cooperation is defined as a complex concept including a willingness to work toward the achievement of agreed-on goal(s) in a manner corresponding to a shared understanding about contributions and payoffs, as well as actions taken by the partners to achieve the stipulated collective goal(s) (Castañer and Oliveira, 2020; Gulati et al., 2012). The reasons for companies to engage in cooperation normally involve sharing of investment risks and pursuing a number of technological, commercial and operational goals that they might be unable to obtain through arm's-length transactional relationships (Oliver, 1990; Gulati et al., 2012). The evolution of cooperative relationships is a concept that has sparked interest of several IOR scholars. Ring and Van de Ven (1994) for example, suggest that cooperative relationships are constantly reevaluated and readjusted based on the actions of the involved parties and the interpretations thereof. They propose that cooperative relationships go through stages of emergence, evolution, and dissolution. Zajac and Olsen (1993) similarly advocate for a dynamic perspective, and propose that cooperative relationships go through stages of initializing, processing and reconfiguration, with feedback loops to prior stages. In such a relationship, participants continually evaluate whether the cooperation is still worthwhile. Explicit definition of terms is important in IORs, as they provide a clear framework, defining each party's rights and obligations, as well as the principles and procedures of the cooperation (Anderson and Dekker, 2005; Luo, 2002). This is even more critical when introducing blockchain technology in IORs, because of the formalized nature of the data exchange, validation, and governance mechanisms. Moreover, blockchain creates a shared information infrastructure between partners and allows for programmable enforcement of rules and agreements. A blockchain represents a common information infrastructure in the sense that all the relevant parties share an identical record of data that has been exchanged according to a network-wide protocol. Research has found that successful inter-firm cooperation is less than straightforward, not least because it requires transaction partners to align their interests, which is a necessary precondition for devoting sufficient efforts to achieve a stipulated common goal (e.g. Salvato et al., 2017). Though partners are free to join or leave, joining a blockchain network requires a priori investments and acceptance of the predefined rules by a given partner firm, which signals commitment to the joint project.

A blockchain project is an inherently cooperative endeavor where partners need to incur significant upfront costs to develop and implement the blockchain system. For firms with existing legacy systems that would need to be completely replaced or made compatible with blockchain this could also include significant switching costs. This runs contrary to the prominent notion that partners in an IOR initially start with small informal deals involving little risk (e.g. Van de Ven, 1976), as potentially high initial investments may create credible commitment (Williamson, 1983) to a joint blockchain project. This would in turn promote transacting, and support cooperation. After the network is operational, information recorded on a blockchain may also enable the establishment of more reliable feedback loops (Ring and Van de Ven, 1994) between partners, and increase transparency within the IOR, thereby contributing to increased confidence in competence and goodwill (Das and Teng, 1998) between partners, which further promotes cooperation. Taken together, these factors should alleviate some adverse selection concerns that would otherwise present an obstacle to cooperation.

Proposition 1: Implementing blockchain in IORs could require significant commitment from partners at the onset of the relationship, but will foster cooperation as the network develops

As partners agree on the on the inputs and outputs of the relationship, a mutual interdependence is created (Pfeffer and Salancik, 1978). This represents a situation in which partners are dependent on one another in various ways to accomplish their organizational goals (Reusen and Stouthuysen, 2020), and become vulnerable to the actions of the other (Parkhe, 1993). This issue is particularly salient in IORs formed between competitors. On the one hand, a firm's rivals can possess the necessary capabilities needed for a joint project. On the other hand, past rivalry might have cultivated the lack of trust and personal dislike (Trapido, 2007). At the same time, according to Davis et al. (1990), competitors are more likely to become aware of one another through professional associations than non-competitors. Stuart (1998) further argues that competitors often choose to cooperate because they are "better able to evaluate and internalize the know-how of technologically similar firms", and to avoid duplication of efforts. This argument is known as "competitive embeddedness", a notion that competition increases mutual awareness, which in turn breeds familiarity and knowledge-based competence trust (Trapido, 2007). Many blockchain projects we observe today are a result of multi-lateral cooperation between heterogeneous sets of actors including industry competitors (Jensen et al., 2019; Mattke et al., 2019), alliance and supply chain partners (Jensen et al., 2019), financial institutions such as banks[20] and insurance firms, as well as authorities and research and educational institutions (Zavolokina et al., 2020). Rival companies form initiatives and consortia (Lacity, 2018; Mattke et al., 2019) in order to address industry inefficiencies with the use of blockchain. Competitive embeddedness is crucial to form these partnerships, as partners get acquainted via professional associations and discuss pressing issues within their industries (Trapido, 2007). At the same time, blockchain technology allows them to share their data in a secure manner. Since confidentiality and control of the data are major issues in inter-firm cooperation, especially between competitors (Bechini et al., 2008), we predict that introducing blockchain technology facilitates new cooperative relationships, which were previously not feasible due to concerns over data security and the inability to integrate numerous and heterogeneous sets of actors.

Proposition 2: Introducing blockchain in IORs is facilitated by existing cooperative relations, and facilitates new ones both in number and nature

[20] For a recent example see: https://www.crowdfundinsider.com/2020/03/158652-standard-chartered-joins-tradelens-a-leading-blockchain-based-supply-chain-management-solution-developed-by-ibm-maersk/

On the one hand, cooperative relationships can provide cost savings, and decrease monitoring costs, which can lead to increases in efficiency and profitability (Smith et al., 1995). On the other hand, the central problem of cooperation is that firms often have only partly overlapping interests, and may pursue incongruent goals if left to their own devices (Ouchi, 1980; Schelling, 1960). Axelrod and Keohane (1985) further argue that cooperation is only possible in situations where there is a combination of complementary and opposing interests. Misaligned interests may cause partners to shirk or try to claim more benefits than initially agreed, through holdup or misappropriation of partners' resources (Gulati et al., 2012). To help explain the success or failure of inter-firm cooperation Axelrod and Keohane (1985) identified three dimensions: The pattern of payoffs, the shadow of the future, and the number of players. Payoffs strongly influence the development and maintenance of cooperation as each relationship partner expects to attain a net positive value from it (Parkhe, 1993). The shadow of the future argument suggests that considerations about the future promote cooperation (Axelrod and Keohane, 1985), as firms compare immediate benefits from deceiving the partners with the loss of potential future gains resulting from breaking an agreement (Telser, 1980). The number of actors and the structuring of their relations can also play a role in inducing cooperation, as it might be difficult to detect and punish the potential defectors when many parties are involved (Axelrod, 1979).

The three dimensions proposed by Axelrod and Keohane (1985) are relevant to consider when implementing blockchain in IORs. Blockchain implementation will require significant investments, so partners will likely need to determine payoffs for each party before they commit to the project. Moreover, the payoffs will depend on the success or failure of the entire network, rather than on individual partners, which should help to align their goals and induce cooperation. As was argued above, the blockchain ledger possesses a critical attribute of tamper-evidence, which improves monitoring through higher transparency of data. As records on the blockchain are tamper evident, the "shadow of the future" should dissuade actors from engaging in opportunistic behavior. Similarly, blockchain's inherent data sharing and governance protocols, the sequential nature of the data recording process, as well as the auditability of the shared ledger should also enable partners to inexpensively and reliably identify a party trying to submit erroneous transactions, irrespective of the number of actors in the network.

Proposition 3: The economic benefits incurred by partners will depend on the success or

failure of the entire blockchain network, which has a positive effect on goal alingnment and fosters cooperation

Even though inter-firm cooperation may lead to different outcomes, one of the most desirable results is achieving effective coordination (Smith et al., 1995). IORs require that at least some of the activities are split between the relationship partners (Sobrero and Schrader, 1998). Inter-firm coordination is defined here as deliberate and orderly alignment or adjustment of partner's actions in the process of determination of common IOR goals, which includes preparation, deliberation, and negotiation between partners (Castañer and Oliveira, 2020; Gulati et al., 2012). Coordination is normally associated with information sharing, decision-making and feedback mechanisms, which aim to align partners' efforts and combine their resources in a productive manner (Gulati et al., 2012). Sobrero and Schrader (1998) differentiate between *contractual* and *procedural* coordination. They define contractual coordination as a reciprocal distribution of rights among the involved partners, highlighting its importance for cooperation development. Procedural coordination on the other hand, involves mutual exchange of information between the parties. It refers to day-to-day communication between partners in a relationship, which allows them to adapt their activities to one another, and handle disputes and exceptions (Sobrero and Schrader, 1998).

Blockchain establishes a common information infrastructure, meaning that all the relevant partners share identical data. This should lead to a significant simplification of procedural coordination, particularly in terms of information sharing and the handling of disputes. A practical illustration are significant efficiency gains in handling shipments between supply chain partners, which in the past involved (and in many cases still do) numerous ad-hoc manual follow-ups through email, phone calls and similar, whereas on a blockchain network mutually-agreed upon decision-relevant data references are made available to all the pertinent parties for given events in near real-time (Jensen et al., 2019). For accounting scholars, and accountants more generally, such an effect is salient because it can markedly improve performance of administrative work in participating partner firms (Anderson and Lanen, 2002). Moreover, programmable rules (i.e. smart contracts) could be used to automate several routine day-to-day procedures even when the data being exchanged is not fully endogenous to the blockchain system. The latter is feasible for highly verifiable and codifiable transactions, which alleviates the "gateway problem", and is further enabled through standardization of data formats, network-wide protocol rules, and tamper-evidence of the ledger, thereby making the execution of these procedures more efficient, as well as more reliable.

Proposition 4: Implementing blockchain in IORs simplifies procedural coordination between partners

The need for coordination stems from the fact that IORs are characterized by mutual interdependence, meaning that each firm is to an extent vulnerable to its partners (Ireland et al., 2002). Coordination scholars have suggested that higher levels of interdependence, along with higher uncertainty and asset specificity, demand more comprehensive forms of coordination (Gulati et al., 2012). Thompson (1967) distinguishes between three different ways in which the work of organizational units may be interdependent, namely pooled, sequential and reciprocal. Pooled interdependence exists in alliances where "each part renders a discrete contribution to the whole, and each is supported by the whole" (Thompson, 1967). As there is little need for serial ordering of activities (Dekker, 2004), the mechanisms to achieve a coordinated outcome in pooled interdependencies are least costly, and involve communication, rules and procedures, and the use of a common data processing center by multiple firms (Kumar and van Dissel, 1996; Gulati and Singh, 1998). In cases of sequential interdependence, partners' activities are distinct and sequentially ordered, meaning that the output of one relationship partner is the input of another. Sequential interdependencies require a higher degree of coordination than pooled interdependence (Gulati and Singh, 1998). Reciprocal interdependencies require still more complex coordination mechanisms (Dekker, 2004), as relationship partners must continuously communicate and adapt to one another (Gulati and Singh, 1998).

Blockchain enables new kinds of distributed architectures, where partners operate in a shared network in the sense that the process through which data is exchanged and recorded relies on responsible and accurate record-keeping by a network of legally independent, and mutually constraining "record keepers". Additionally, smart contracts allow for reliable automatic execution and enforcement of pre-defined agreements based on either transactional data that is endogenous to the blockchain or exogenous data references in explicit transactions. These functionalities inherently imply mutual interdependence and sequential interaction between involved parties. Accordingly, they mandate that partners standardize their data and align their processes already in the startup phase of the project. As was mentioned above, a blockchain project can bring together a multitude of heterogeneous partners. The project might start as an alliance, but once established, the blockchain network can expand to include other IOR partners such as industry rivals, suppliers, service providers, and authorities (Jensen et al., 2019). The interdependencies between partners in different parts on the network may collectively fall under any or all of the three archetypes described above (Thompson, 1967). The partners will be required to both carefully develop a network at the outset of the project (through data standardization and process alignment), as well as jointly maintain it after it becomes operational (through governance rules and multi-party consensus over shared sets of data) (Rauchs et al., 2019). Although the exact intensity and direction of the effect will likely be contextual and dependent on numerous factors (e.g. ex ante governance arrangements and prior interactions between partners in a newly formed network, stipulated goals of the collaboration, etc.), we expect that a blockchain implementation project will impact the nature of interdependencies between partners in the pertinent network.

Proposition 5: Blockchain impacts the nature of interdependencies between IOR partners both in the startup phase, as well as in the operational phase of the partnership

6.3. Trust

The concept of trust has been widely discussed across several different disciplines, including accounting, economics, psychology, sociology, and philosophy. Rousseau et al. (1998) analyzed the meaning of trust across disciplines, and concluded that basic elements and definitions are "not so different after all". They define trust as a "psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behavior of another" (p. 394). Development of inter-firm trust is often argued to be the basis for maximizing the value of IORs (Ireland et al., 2002). Trust can reduce transaction costs (Gulati, 1995), spur desirable behavior, lead to decreased levels of conflict, facilitate coordination by enabling greater knowledge and information transfer (Poppo et al., 2016), increase managerial flexibility, and reduce concerns about opportunistic behavior (Gulati et al., 2012). Since it is most often impossible to manage all risks through formal agreements and controls, firms in IORs often at least partly rely on trust to facilitate collaboration (Dekker, 2004; Emsley and Kidon, 2007; Reusen and Stouthuysen, 2020). Prior research has identified different forms of trust, contingent on the bases from which it is reached. A commonly used classification in management accounting studies of IORs differentiates between *competence trust* and *goodwill trust* (e.g. Dekker, 2004;

Anderson et al., 2017b; Reusen and Stouthuysen, 2020). While competence trust refers to a partner’s technical *ability* to perform activities as agreed in the contract (Dekker, 2004), goodwill trust refers to a firm’s confidence in predicting partner’s *intentions* to act as agreed (Nicolaou et al., 2011).

It should be pointed out however, that this is neither the only categorization found in the IOR literature, nor do all authors use the same terminology. Another prominent classification is provided by Poppo et al. (2016), who distinguish between *calculative trust* (Williamson, 1993), where managers believe that the costs of acting opportunistically, which refer to the forgone future value of transactions, will be greater than the benefits associated with opportunistic actions; and *relational trust*, which emerges from social relationships, where there is a strong belief about the goodwill and honesty of others. Susarla, Holthacker, and Krishnan (2020) discuss two major sources of calculative trust. The first source reflects the potential of future economic gains from continued exchange, which has an important disciplining effect on exchange partners to adhere to informal agreements (Baker et al., 2002), and show willigness to be vulnerable to the actions of the other (Mayer et al., 1995). This disciplining effect has often been referred to in the IOR literature as the “shadow of the future” (e.g. Axelrod and Keohane, 1985), which more specifically refers to the threat of terminating the collaboration and thereby foregoing all potential future benefits resulting from it (Gibbons and Henderson, 2012). The second source of calculative trust is partners’ bilateral reputation for satisfactory performance in prior contracting, which assuages partners’ fear of performance failure despite full cooperation, or in other words reduces performance risk (Susarla et al., 2020; Das and Teng, 1998; Anderson and Dekker, 2009). This reputation represents an intangible economic asset (Klein and Leffler, 1981; MacLeod, 2007) and arises as partners observe each other’s performance over repeated interactions, from which they infer commitment to uphold contractual agreements (Susarla et al., 2020).

Blockchain is often referred to as the “trust-less” technology (e.g. Xu et al., 2017) which might imply that it has the potential to replace trust within and between organizations. This assertion may not necessarily be correct. While blockchain’s cryptography and consensus mechanisms are able to replace trusted intermediaries when transferring cryptocurrencies, the same does not apply to IORs. Namely, entries in permissioned blockchain implementations (e.g. in supply chains) often refer to exogenous data sources. While asset ownership might be verified by blockchain records, its condition, location and worth must still be assured (ICAEW, 2017). Although the blockchain, in and of itself, cannot prevent a party from breaking an agreement, or act opportunistically, inbuilt mechanisms could decrease the possibilities for opportunism. Research has found that third-party information based on a partner's history of cooperation with other firms, even in the absence of own knowledge based on prior interactions enables the formation of trust through a *transference* process (Donney and Cannon, 1997; McEvily et al., 2003), where third parties "roll over expectations" from existing relationships to newly formed ones (Uzzi, 1997). In permissioned blockchains, network participants are often "competitively embedded" (Trapido, 2007) vetted partners. In a recent study, Reusen and Stouthuysen (2020) report that third-party information has a significant effect on partners' level and dimensions of trust through "trust transfer". The premise behind this "trust transfer" is that, other than being based on own prior experience with a given partner, initial trust impressions are also influenced by the cues provided by third parties, such as other firms in a given industry (Reusen and Stouthuysen, 2020). More specifically, simply knowing other firms that trusted an IOR partner is sufficient for participants' competence trust to increase. In a blockchain network, such "third-party" information can be obtained simply by observing sucessfully executed transactions between other (vetted) participants, even when a given partner is not privy to specific information contained in a "channel" in which only directly participating or otherwise designated parties may have read, write and/or validation rights. On the other hand, goodwill trust is only found to increase when information about positive outcomes are available (Reusen and Stouthuysen, 2020). Achieving this effect in a blockchain network of vetted participants is likely, although it might necessitate more detailed information about interactions beyond mere successful transaction execution in some cases. Combined, these features imply that in a blockchain network, the transacting parties need not establish expectations regarding partners' behavior, nor build confidence regarding partners' goodwill solely based on their direct past experience or the ongoing direct interactions with those partners (Lumineau et al., 2020).

Regular monitoring of tamper-evident blockchain records by relevant parties, coupled with the disciplining effect of "trust transfer", would increase the probability of opportunistic behavior being detected and sanctioned, not just by the parties directly involved in a given transaction, but by the entire blockchain network. Consequently, the combined effect of potential unavailability of detailed information about other participants' interactions and the "shadow of the future" (Baker et al., 2002) should prompt IOR partners to adopt a more "calculative" approach to transacting. Moreover, the transference effect (Reusen and Stourhuysen, 2020) of trust between network participants could help establish a multilateral reputation (Susarla et al., 2020) system in the network, thereby increasing the overall level of both competence and goodwill trust.

Proposition 6: Introducing blockchain in IORs leads to more reliance on calculative trust as opposed to relational trust

Proposition 7: Introducing blockchain in IORs increases the level of both competence and goodwill trust among partners

6.4. Inter-organizational control

An extensive body of literature in management accounting examines governance choices of firms in IORs, explicitly recognizing the conditions that precede and largely determine these choices (e.g. the threat of partner opportunism and coordination of inter-firm tasks), as well as ways in which firms acquire information about their partners (Anderson and Dekker, 2005; Williamson, 1985; Dekker, 2004; Neumann, 2010). Selecting an appropriate partner in an IOR has been identified as an important way in which firms can mitigate control problems, with some studies suggesting that identifying a suitable partner is critical for the success of IORs (e.g. Ireland et al., 2002), and that the partner selection phase can strongly influence latter stages of the collaboration since it precedes and informs the design of contractual and other management control structures (Dekker, 2004; 2008). "Partner selection" is here referred to as the process of searching for, evaluating, and ultimately selecting a transaction partner (Dekker, 2004, 2008; Ding, et al., 2013). Management accounting studies conceptualize partner selection as an explicit ex ante management control choice in IORs in response to the underlying transaction hazards (e.g. Dekker, 2008; Ding et al., 2013). In these studies, the partner selection process is analyzed in terms of the time spent by firms to find exchange partners, the effort exerted to evaluate them (which includes the development of evaluation criteria), as well as the relative importance placed on different selection criteria in the choice of a partner (Dekker, 2008; Dekker and Van den Abbeele, 2010; Ding et al., 2013). The evaluation criteria include those that relate to partners' reliability and technological competencies, as well as screening of multiple suppliers and information search in networks of related parties to acquire relevant information (Mitchell and Fitzgerald, 1997; Dekker and Van den Abbeele, 2010).

The transacting partners in a blockchain network are obligated to behave according to the collective agreement, including the technical consensus protocol, as deviating behaviors would not be verified neither by the algorithm, nor other nodes in the system (Catalini and Boslego, 2019). The underlying logic is not to engage in formulating elaborate terms that could be used to seek legal recourse for ex post partner malfeasance, but rather to regulate the actions of partners from the outset (Lumineau et al., 2020). Blockchain architecture provides a resilient, replicated, sequentially ordered record of interactions between partners maintained by a network of legally independent actors. The latter characteristic is related to the tamper-evident nature of a blockchain ledger, meaning that relevant parties can readily observe and prevent potential malfeasance through some form of a "majority" vote on the state of records (i.e. the consensus mechanism). These characteristics significantly increase the reliability of records. Reliable records validated in a decentralized manner provide a robust "third party" signal of competence and benevolence of transacting partners for the entire network (Reusen and Stouthuysen, 2020), in most cases irrespective of specific levels of data-access authorization, as was argued above. Similarly, partners are free to join or leave the blockchain network, but going through the "onboarding" process and joining the network implies that a given partner accepts the predefined governance rules (Lumineau et al., 2020). As such, the willingness of a partner to participate in a network characterized by tamper-evident records and involving automated execution of codified agreements can be seen as a precommitment not to behave opportunistically in the future (Yermack, 2017), and a signal both of the intention and the ability of partners to honor the agreements (Lumineau et al., 2020). Furthermore, the sequentially ordered history of interactions consisted of data in a standardized format that typifies a blockchain ledger makes ex post observation of prior interactions less costly and less time-consuming. This can, in combination with the reliability of blockchain records and the "third party signals" (Reusen and Stouthuysen, 2020) mitigate transaction hazards by building a credible reputation system for IOR partners in a blockchain network, redefining the payoff structures of deviating behaviors in the process (Lumineau et al., 2020). Hence, in an IOR context, blockchain technology could have profound implications for the partner selection process. Namely, the combined effect of the reliability of records, ex ante deterrence effect of opportunistic potential partners, and the greater ease of observability of prior interactions should improve the process of informing and designing evaluation criteria for potential partners, and reduce partner search and selection costs in IORs.

Proposition 8: Blockchain technology mitigates control problems in IORs through improved partner selection

Contracts are legally enforceable, voluntarily initiated documented agreements between exchange partners that govern their relationship and incorporate procedures, incentives, mutual obligations and dispute-resolution mechanisms, thereby providing a framework for inter-firm cooperation (Schepker et al., 2014). Contracts help to achieve cooperation and coordination by specifying rights and responsibilities of each party, particuralize the deliverable outcomes, clarify procedures for monitoring and penalties for non-compliance, and put forth conflict resolution procedures (Ding et al., 2013; Poppo and Zenger, 2002). As such, they are primarily used to control verifiable actions and outcomes. Contracts can take a variety of forms, from standard, boilerplate to highly customized; from explicit and "complete" to more open, containing "incomplete" formulation of task execution and output; from arm's length where the identity of the partners is irrelevant, to highly complex and multi-layered (Schepker et al., 2014). Contract complexity refers to the number and stringency of provisions in a contract (Reuer and Ariño, 2007). Complex contracts understood this way are detailed and costly to develop and implement, as they include a large number of specific terms, clauses and covenants, and contain detailed agreements that serve to clarify monitoring procedures for non-compliance, and describe conflict resolution procedures that are collectively used to mitigate potential transaction hazards (Ding et al., 2013; Luo, 2002). Multiple studies argue that contracts are an integral part of the management control structure of IORs. A prominent stream of research focuses on contractual clauses that are aimed at aligning and safeguarding partners' interests, and facilitating coordination and adaptation (e.g. Williamson, 1985; Anderson and Dekker, 2005; Reuer and Ariño, 2007). Other studies (e.g. Banker et al., 2006) emphasize that a shared information exchange infrastructure between partners enables greater contract completeness by making monitoring additional dimensions of partner performance more economical. Here, the conceptualization of inter-firm contracts distinguishes between aspects of partner activities that should be included in the contract, and those that should be monitored.

As was argued above, fundamental technical and governance characteristics of blockchain technology improve reliability and ex post observability of records shared between partners. Additionally, smart contracts enable the routinisation of inter-firm processes involving blockchain-endogenous data and explicit exogenous (i.e. standardized, codifiable and verifiable) data references, reducing them to a set of articulated interaction patterns that are automatically executed when pre-defined conditions are met. The monitoring and the execution phase of this process incur no additional direct costs. Organizing transactions in such a manner allows for (at least partial) enforcement through pre-defined rules, without recourse to the traditional legal system external to the blockchain and the IOR (Werbach, 2018). The aforementioned standardization of data formats and execution patterns inherent to blockchain serve to make transactional interactions between partners in IORs more predictable, while the decentralized governance mechanisms establish clear decision-making rules regarding the data exchanged in the network. Furthermore, sequential ordering of redundantly stored data among participants in the network, and the resulting tamper-evidence of the records greatly simplify dispute resolution. Taken together, and to the extent that they refer to blockchain-endogeneous or otherwise explicit transactions, blockchain functionalities and smart contracts allow for more partner activities to be reliably monitored. Taking the argument one step further, the introduction of blockchain could induce firms to preemptively (i.e. before joining the network) change their transactional practices to fit the requirements of standardization, codifiability and verifiability, in essence changing the nature of the transactions. Accordingly, this would enable the scope of the activities that can be reliably automatically executed, enforced and monitored through blockchain to be expanded even further. The contract literature suggests that greater exchange hazards induce firms to invest in more complex contracts (e.g. Anderson and Dekker, 2005). Similarly, we contend that the functionalities of blockchain technology and smart contracts described above narrow the domain around which parties can be opportunistic (Poppo and Zenger, 2002), and reduce information asymmetry between partners in IORs. This, in turn, lowers transaction hazards and reduces the scope of activities that IOR partners need to include in formal contracts, leading to lower demand for contract complexity.

Proposition 9: Blockchain technology fosters the design of less complex contracts in IORs

6.5. Information exchange

Over the past several decades, the boundaries of a single organization have lost some of their explanatory power in defining the relevant entity for management control in many firms. The emergence of technologies for information collection, conversion, dissemination and monitoring within and across organizational boundaries has played an important role in enabling inter-organizational collaboration. Technology-enabled inter-organizational information systems (IIS) often represent a primary means of information exchange across company borders in IORs (Gulati and Singh, 1998). As such, they play a significant role in the control of IORs, represent an important source of competitive advantage, and are ultimately critical to the success of inter-organizational collaboration (Anderson and Sedatole, 2003; Nicolaou et al., 2011).

At the most basic level, the purpose of adopting IIS is to implement computerized communications among partnering organizations. Studies investigating control and performance implications of IIS use broadly identify information sharing, standardization and process integration as practices that facilitate mutual value creation. In this context, information sharing reflects the extent to which partners exchange decision-relevant information via IIS (Schloetzer, 2012). Process integration is here referred to as the extent to which partners standardize and synchronize inter-firm processes, which are in turn defined as a set of interrelated and sequential activities that are shared and executed by two or more trading entities (Schloetzer, 2012). In the IIS context, standards are defined as a set of technical specifications that are agreed upon and used by IIS developers to describe data formats and communication protocols, which enable computer-to-computer communication, and in turn facilitate inter-organizational information exchange (David and Greenstein, 1990; Zhu et al., 2006). For the purposes of this paper, IIS are defined as technology-enabled information systems used by two or more organizations that can facilitate creation, storage, and transmission of different types of information (e.g. operational, accounting, performance, contractual and/or strategic information) across firm boundaries (Nicolaou et al., 2011; Christ and Nicolaou, 2016; Kumar and van Dissel, 1996).

The records in a blockchain network are considered valid only after a uniform view on the state of the shared ledger and the order of events (i.e. a consensus) has been reached on a collective level (a part of the network such as a channel or the whole network, depending on the design choices). In other words, blockchain necessitates validation of actions (e.g. exchange of decision-relevant information) by multiple independent entities. This mechanism could entail high overhead costs, since the same data records need to be replicated and maintained by multiple parties (Kumar et al., 2020). Concomitantly, that same mechanism increases data integrity and reliability, as data points from multiple independent sources converge towards shared, mutually agreed upon, authoritative sequential states of records valid for the entire network. As a result, the use of blockchain is likely to significantly reduce the costs and task complexity related to the reconciliation of records, as it essentially collapses the two processes of data exchange and reconciliation of records into one. This is especially relevant in IORs, where partner interactions can be multi-tiered, and between heterogeneous parties (e.g. alliance partners from different industries, multiple suppliers, service providers, regulators). Studies have shown that a centralized (e.g. hub-and-spoke) design is pervasive in existing IIS solutions (e.g. Hart and Saunders, 1997; Kumar et al., 2020), including data exchange on a point-to-point basis (e.g. through electronic data interchange (EDI) or Extensible Markup Language (XML)-based standards) (Steinfield et al., 2011). This makes the flow of information between partners less than seamless, especially in multi-tier IORs such as extended supply chains (Steinfield et al., 2011), and increases the marginal costs of integrating new partners (Babich and Hilary, 2020). Taken together, this promotes an increase in transaction hazards and the consequent management control issues.

In the context of IORs, blockchain can be seen as a new form of IIS. In that sense, it is comparable to other technologies which are intended for inter-firm communication, the most prominent example being EDI. EDI enables standardized point-to-point inter-organizational communication between independent computerized information systems, which makes them suitable for dyadic (i.e. one-to-one) or hub-and-spoke (i.e. one-to-many) information exchange between partners (Anderson and Lanen, 2002). EDI is a widely-used, long-standing and mature techology that can be highly effective in standardized exchanges of information such as procurement orders (Clemons et al., 1993). However, EDI mainly serves as a support tool in inter-firm information exchange because it lacks the ability to automatically enforce agreements (Kumar et al., 2020; Lumineau et al., 2020). The capability of autonomous enforcement without recourse to external governance apparatus (e.g. the legal system) represents a unique characteristic of smart contracts that run on blockchain, which differentiates it from other IIS solutions like EDI (Lumineau et al., 2020). Although limited by the issues of endogeneity of data references and the overall transaction standardization, codifiability and verifiability, this is nevertheless a very promising feature in the context of IORs. In sum, blockchain's core attributes enable end-to-end, multi-lateral (i.e. many-to-many or network-based) information exchange between partnering firms, as well as implementation and autonomous enforcement of agreements/business logic codified in smart contracts (Beck et al., 2018; Kumar et al., 2020), which makes them suitable for multi-lateral collaboration among partners in IORs.

Proposition 10: Blockchain technology enables many-to-many information exchange between partners and thus facilitates multi-lateral collaboration in IORs

The information exchanged via IIS has itself been an important topic of inquiry among management accounting scholars. Here, a distinction has been made between coordination and control uses of this information. Regarding the former, information is used as a means of planning and coordinating the interdependent activities that the collaborating parties collectively engage in (Nicolaou et al., 2011). When the primary goal of information use is control, the information is used to verify and evaluate the actions of the partner, usually by monitoring performance information with the goal of incentivizing or compelling the partner into achieving desirable or predetermined results (Nicolaou et al., 2011).

Inherent technical attributes of blockchain technology entail that the shared, mutually agreed-upon, tamper-evident records of exchanged information contain the attributes of transparency, auditability, and consistency across databases of the involved parties. These attributes have a disciplining effect on these parties by imposing high costs (e.g. exclusion from the network) on individual participants (or an insufficiently large group of participants) that attempt to unilaterally make changes to the records or propose fraudulent claims. Furthermore, programmable self-executing rules (i.e. smart contracts) enable automated enforcement of interactions between partners. A primary way in which control is implemented via IIS is by using the system as a diagnostic tool, which means that performance information is gathered and monitored after the actions have been taken (Baiman and Demski, 1980; Nicolaou et al., 2011). Consequently, introducing blockchain as the IIS in IORs should reduce control complexity through improved monitoring, self-disciplining mechanisms, and simplified performance evaluation.

Proposition 11: Blockchain technology reduces information exchange-related control complexity in IORs

An aspiration to improve inter-organizational coordination through the use of IIS exhibited by an increasing number of firms has led to the development of new network standards (Zhu et al., 2006). Studies focusing on the development and diffusion of data and process standards beyond a dyadic buyer-supplier relationship (i.e. “extended supply chain” or industry level) have reported that achieving the goal of establishing a common information infrastructure is fraught with difficulties.

These include factors such as heterogeneity of interests among partners (Markus et al., 2006), high cost of implementation and low reuse value of the investment for smaller partners (Steinfield et al., 2011), and difficulties in reaching an agreement on design, governance structure, and ownership of the solution. This can result in a vicious cycle where partners hold off investments, possibly rendering the whole collaboration unsuccessful (Simcoe, 2012; Steinfeld et al., 2011). Formation of industry-wide standard setting consortia has been proposed as a way to address these issues. Using Olson's (1965) seminal work on collective action as a theoretical basis, Weiss and Cargill (1992) suggest that standards development consortia[21] have an incentive to limit membership to a group of participants with a compatible preference structure, especially large firms because they are more likely than smaller ones to influence others to adopt the standard. Furthermore, developing industry-wide IIS standards requires joint efforts across organizational boundaries, making the potential benefits of the solution contingent on the status of network adoption by the rest of the firms in the industry (Zhu et al., 2003).

Basic requirements for the feasibility of the use of blockchain technology include standardization (e.g. of data formats and consensus mechanisms), wide adoption, and interoperability between different individual platforms (e.g. Lacity, 2018; Kumar et al., 2020). Some authors (e.g. Kumar et al., 2020) have suggested that after standards have been developed by consortia that individually could include a limited number of large firms (Weiss and Cargill, 1992), the rollout of the technology is regardless likely to happen on a much wider scale and in collaboration with IT vendors and different actors in a given industry. Since blockchain interoperability is one of the key requirements for the success and the diffusion of the technology (Kumar et al., 2020), cross-platform and cross-consortia collaboration will be a major factor in its adoption.[22] Taken together, these arguments imply that, in blockchain-based IIS networks, most of the benefits are expected after the compatible blockchain platforms have reached a high level of diffusion. Moreover, due to the novelty of the technology and the associated lack of technical capabilities within some firms, setup costs of a blockchain network might be higher than for existing technological solutions (Kumar et al., 2020). These can be exacerbated by blockchain's inherent replicated

[21] Weiss and Cargill (1992) refer to consortia that include organizations whose primary role is to facilitate the adoption of standards through promotional activities and compatibility testing, and those that are actively developing the technology that represents the basis of either de facto or voluntary consensus standards.
[22] For more details on the recently announced collaboration between rival IT vendors IBM, Oracle, and SAP, and their efforts to „connect the chains" used by different consortia see: https://www.coindesk.com/old-rivals-oracle-and-ibm-want-their-blockchains-to-talk-to-each-other.

storage requirements. Consequently, it is reasonable to expect that in situations where marginal overhead costs of running transactions are high as well as when difficulties with integrating different IOR partners exist, a more mature technology such as EDI might still prevail. We therefore suggest that wide adoption characterized in some combination by the number and heterogeneity of participants represents a major factor for blockchain adoption.

Proposition 12: Blockchain technology is best suited for IORs that involve numerous and/or heterogeneous partners

7. Conclusion

Several authors (e.g. Beck et al., 2018; Werbach, 2018) have argued that blockchain is a multi-faceted innovation, namely technical (a new distributed version of a transactional database), economic (offering a reliable record of transactions in a decentralized, adversarial environment), and organizational, given that it may fundamentally change how firms organize IORs. The purpose of this paper is to develop a research agenda for accounting scholars examining the implications of blockchain technology in IORs. We do so by relying on literature on IORs primarily in management accounting, but also in related fields such as organizational and information systems research. The underlying logic of our approach takes into consideration that, just like blockchain techology itself, IORs are a multi-faceted phenomenon. Several authors (e.g. Smith et al., 1995; Dekker, 2004) suggest that different theoretical perspectives should be applied to the study of IORs, as it is unlikely that a single one will provide a thorough understanding of the complexities of this phenomenon. This is seen as especially relevant when it is analyzed in conjunction with another complex phenomenon like blockchain. To that end, we identify four areas in the IOR literature, namely collaboration, trust, inter-organizational control, and information exchange. Within each of these areas, we outline some of the most commonly recurring issues, inform the discussion with preceding analysis of blockchain technology and synthetize the arguments into several theoretical propositions, indicating how the technology could have an impact in the described settings. This process seeks to address a broad overall question: what novel problematizations does blockchain technology invite in the study of IORs? Our approach allows us to offer insights and suggest additional avenues for future research from several perspectives relevant to management accounting researchers.

Firstly, implementation of blockchain technology gives rise to new questions regarding inter-firm cooperation through its different stages (e.g. Zajac and Olsen, 1993; Ring and Van de Ven, 1994). Here, a potential avenue for future research includes elucidating initial conditions for the establishmnent and those for the evolution of a blockchain network. This includes, but is not limited to, research questions such as:

- How does blockchain impact the performance of IORs?
- What effect does establishing a common information infrastructure through blockchain between heterogeneous sets of partners have on firm boundaries?
- How do potentially conflicting objectives of exchange partners influence goal alignment, and as a corollary the level of cooperation in the blockchain network?
- What effect do prior ties between IOR partners have on the formation dynamics and governance of a blockchain network?

Secondly, studies could focus on issues regarding inter-firm coordination. Some interesting questions to explore include:

- What are the factors that influence partners' effectiveness in collaborating through a blockchain network?
- What effect will the standardization of day-to-day communication through blockchain and the establishment of multi-lateral ties between partners have on the administrative work of accountants in partnering firms?
- How will interdependencies between IOR partners be impacted by the implementation of blockchain? How will these effects vary with different governance choices in blockchain networks? How will this affect the payoff structure for partners?

Thirdly, we direct scholars' attention to the issues related to the design and use of management control mechanisms in IORs. As was argued above, blockchain establishes a reliable "third party" source of information (Reusen and Stouthuysen, 2020) and a "multi-lateral reputation system" (Susarla et al., 2020), which can have profound effects on inter-firm trust (Dekker, 2004). The analysis of the interrelations between informal (e.g. trust) and formal management control mechanisms in IORs provides various possible directions for future research which could include the following research questions:

- What are the new management control mechanisms enabled by blockchain that support collaboration in IORs?
- How does inter-firm trust influence the subsequent operationalization of the blockchain network? How do blockchain-enabled multi-lateral information flows dynamically influence inter-firm trust during the course of the relationship?

Formal ex ante and ex post management control mechanisms covered in this paper, namely partner selection and contracting have been identified in the literature as interrelated concepts (e.g. Ding et al., 2013; Dekker, 2008). When considering the effect of blockchain technology in IORs, several promising lines of inquiry could be explored:

- How does blockchain affect partner selection in IORs? How does it affect inter-firm contracting practices?
- What is the relationship between partner selection efforts and contract complexity in IORs where partners use blockchain as a common information infrastructure?

Finally, exchange of decision-relevant information between IOR partners has been extensively studied by management accounting scholars (e.g. Baiman and Rajan, 2002; Schloetzer, 2012; Christ and Nicolaou, 2011). While notable contributions have been made in this research stream, several studies (e.g. Caglio and Ditillo, 2008; Kornberger et al., 2017; Thambar et al., 2019) have pointed out that, with a few exceptions, most of these studies focus on dyadic or one-to-many inter-firm relations, typically from the viewpoint of a dominant IOR partner. As a result, the conceptualization of management control mechanisms has been wedded to the notions of hierarchy and the "visible hand" searching for efficiency in strictly defined IOR forms (e.g. strategic alliances, buyer-supplier relationships) (Hopwood, 1996; Kornberger et al., 2017). Blockchain technology as a common information infrastructure enables multi-lateral collaboration between partners from different IORs, as traditionally defined, and as such invites a promising (though not exhaustive) set of research questions:

- What inter-firm management control mechanisms can be used to govern a blockchain-enabled multi-lateral collaboration effort?

- When is blockchain superior to, or preferred over existing IIS solutions as a common information infrastructure in IORs? What are the factors that influence firms to choose one over the other?

For several decades, management control issues in IORs have been an important topic of inquiry among accounting scholars. We hope that the propositions developed in this paper, together with the suggested questions for further research, will support laying the groundwork for management accounting researchers interested in blockchain in the context of IORs. The research agenda outlined in this paper is aimed at inspiring interesting research questions the answers to which could increase our understanding of blockchain technology as an inter-organizational phenomenon, and foster the development of a more comprehensive notion of IORs and management controls that are used to sustain them.

References

Abadi, J. and Brunnermeier, M. (2018). *Blockchain economics*. National Bureau of Economic Research. *Available at*: https://scholar.princeton.edu/sites/default/files/markus/files/blockchain_paper_v7a.pdf

Anderson, S. W., & Lanen, W. N. (2002). Using electronic data interchange (EDI) to improve the efficiency of accounting transactions. *The Accounting Review, 77(4)*, 703-729.

Anderson, S. W., Chang, H. F., Cheng, M. M., & Phua, Y. S. (2017). Getting to know you: trust formation in new interfirm relationships and the consequences for investments in management control and the collaboration. *Contemporary Accounting Research, 34*(2), 940-965.

Anderson, S. W., Christ, M. H., Dekker, H. C., & Sedatole, K. L. (2014). The use of management controls to mitigate risk in strategic alliances: Field and survey evidence. *Journal of Management Accounting Research, 26*(1), 1-32.

Anderson, S. W., & Dekker, H. C. (2005). Management control for market transactions: The relation between transaction characteristics, incomplete contract design, and subsequent performance. *Management science, 51*(12), 1734-1752.

Anderson, S. W., & Dekker, H. C. (2009). Strategic cost management in supply chains, part 1: Structural cost management. *Accounting Horizons*, *23*(2), 201-220.

Anderson, S.W. & Dekker, H.C. (2014). The Role of Management Controls in Transforming Firm Boundaries and Sustaining Hybrid Organizational Forms. *Foundations and Trends® in Accounting* 8 (2): 75-141.

Anderson, S. W., Dekker, H. C., & Van den Abbeele, A. (2017). Costly control: An examination of the trade-off between control investments and residual risk in interfirm transactions. *Management Science*, *63*(7), 2163-2180.

Anderson, S. W., & Sedatole, K. L. (2003). Management accounting for the extended enterprise. *Management accounting in the digital economy*, 36.

Anthony, R.N. (1965). Planning and Control Systems: A Framework for Analysis. *Division of Research, Harvard Business School*.

Arrow, K. (1985). The Economics of Agency. *In Pratt, J., Zeckhauser, R. (Eds.), Principals and Agents: The Structure of Business*. Cambridge, Mass: Harvard University Press.

Axelrod, R. (1979). The Rational Timing of Surprise. *World Politics* 31 (2): 228-246.

Axelrod, R., & Keohane, R. O. (2018). Achieving cooperation under anarchy: Strategies and institutions. In *Cooperation under anarchy* (pp. 226-260). Princeton University Press.

Babich V. and Hilary, G. (2020). Distributed Ledgers and Operations: What Operations Management Researchers Should Know About Blockchain Technology. *Manufacturing & Service Operations Management* Vol. 22, No. 2.

Baiman, S., & Demski, J. S. (1980). Economically optimal performance evaluation and control systems. *Journal of Accounting Research*, 184-220.

Baiman, S., & Rajan, M. V. (2002). The role of information and opportunism in the choice of buyer-supplier relationships. *Journal of Accounting Research, 40*(2), 247-278.

Baker, G., Gibbons, R., & Murphy, K. J. (2002). Relational Contracts and the Theory of the Firm. *The Quarterly Journal of Economics, 117*(1), 39-84.

Banker, R. D., Kalvenes, J., & Patterson, R. A. (2006). Research note—information technology, contract completeness, and buyer-supplier relationships. *Information Systems Research*, 17(2), 180-193.

Bechini, A., Cimino, M. G., Marcelloni, F., & Tomasi, A. (2008). Patterns and technologies for enabling supply chain traceability through collaborative e-business. *Information and Software Technology, 50*(4), 342-359.

Beck, R., Müller-Bloch C., & King, J.L. (2018). Governance in the Blockchain Economy: A Framework and Research Agenda. *Journal of the Association for Information Systems*. 19(10):1020-1034.

Caglio, A., & Ditillo, A. (2008). A review and discussion of management control in inter-firm relationships: Achievements and future directions. *Accounting, Organizations and Society, 33*(7-8), 865-898.

Caglio, A., & Ditillo, A. (2012). Opening the black box of management accounting information exchanges in buyer–supplier relationships. *Management Accounting Research,* *23*(2), 61-78.

Castañer, X., & Oliveira, N. (2020). Collaboration, coordination, and cooperation among organizations: Establishing the distinctive meanings of these terms through a systematic literature review. *Journal of Management, 46*(6), 965-1001.

Catalini, C., & Boslego, J. (2019). *Blockchain technology and organization science: Decentralization theatre or novel organizational form*. Working Paper, Massachusetts Institute of Technology, Cambridge.

Catalini, C., & Gans, J. S. (2016). *Some simple economics of the blockchain (No. w22952)*. National Bureau of Economic Research. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2874598

Christ, M. H., & Nicolaou, A. I. (2016). Integrated information systems, alliance formation, and the risk of information exchange between partners. *Journal of Management Accounting Research*, *28*(3), 1-18.

Clemons, E. K., Reddi, S. P., & Row, M. C. (1993). The impact of information technology on the organization of economic activity: The "move to the middle" hypothesis. *Journal of management information systems, 10*(2), 9-35.

Clemons, E. K., & Hitt, L. M. (2004). Poaching and the misappropriation of information: Transaction risks of information exchange. *Journal of Management Information Systems, 21*(2), 87-107.

Coad, A. F., & Cullen, J. (2006). Inter-organisational cost management: Towards an evolutionary perspective. *Management Accounting Research, 17*(4), 342-369.

Coletti, A. L., Sedatole, K. L., & Towry, K. L. (2005). The effect of control systems on trust and cooperation in collaborative environments. *The Accounting Review, 80*(2), 477-500.

Cong, L. W., & He, Z. (2019). Blockchain disruption and smart contracts. *The Review of Financial Studies, 32*(5), 1754-1797.

Coyne, J. G., & McMickle, P. L. (2017). Can blockchains serve an accounting purpose?. *Journal of Emerging Technologies in Accounting*, *14*(2), 101-111.

Coase, R.H. (1937). The Nature of the Firm. *Economica* 4 (16): 386-405.

Dai, J., & Vasarhelyi, M. A. (2017). Toward blockchain-based accounting and assurance. *Journal of Information Systems*, *31*(3), 5-21.

Das, T. K., & Teng, B. S. (1998). Between trust and control: Developing confidence in partner cooperation in alliances. *Academy of management review, 23*(3), 491-512.

David, P. A., & Greenstein, S. (1990). The economics of compatibility standards: An introduction to recent research. *Economics of innovation and new technology, 1*(1-2), 3-41

Dekker, H. C. (2004). Control of inter-organizational relationships: evidence on appropriation concerns and coordination requirements. *Accounting, organizations and society, 29*(1), 27-49.

Dekker, H. C. (2008). Partner selection and governance design in interfirm relationships. *Accounting, Organizations and Society, 33*(7-8), 915-941.

Dekker, H. C., Sakaguchi, J., & Kawai, T. (2013). Beyond the contract: Managing risk in supply chain relations. *Management Accounting Research*, *24*(2), 122-139.

Dekker, H. C., & Van den Abbeele, A. (2010). Organizational learning and interfirm control: The effects of partner search and prior exchange experiences. *Organization science, 21*(6), 1233-1250.

Ding, R., Dekker, H. C., & Groot, T. (2013). Risk, partner selection and contractual control in interfirm relationships. *Management Accounting Research*, *24*(2), 140-155.

Doney, P. M., & Cannon, J. P. (1997). An examination of the nature of trust in buyer–seller relationships. *Journal of marketing, 61*(2), 35-51.

Dulleck, U., Kerschbamer, R., & Sutter, M. (2011). The economics of credence goods: An experiment on the role of liability, verifiability, reputation, and competition. *American Economic Review, 101*(2), 526-55.

Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of management review*, *23*(4), 660-679.

Emsley, D., & Kidon, F. (2007). The relationship between trust and control in international joint ventures: Evidence from the airline industry. *Contemporary Accounting Research*, *24*(3), 829-858.

Gans, J.S. (2019). The Fine Print in Smart Contracts. *NBER Working Paper No. 25443*. Available at: https://www.nber.org/papers/w25443

Gibbons, R., & Henderson, R. (2012). Relational contracts and organizational capabilities. *Organization science, 23*(5), 1350-1364.

Glaser, F. (2017). Pervasive decentralisation of digital infrastructures: a framework for blockchain enabled system and use case analysis. *Available at*: https://pdfs.semanticscholar.org/859d/0535e16095f274df4d69df54954b21258a13.pdf

Grafton, J., & Mundy, J. (2017). Relational contracting and the myth of trust: Control in a co-opetitive setting. *Management Accounting Research, 36,* 24-42.

Gulati, R. (1995). Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. *Academy of management journal, 38*(1), 85-112.

Gulati, R., & Singh, H. (1998). The architecture of cooperation: Managing coordination costs and appropriation concerns in strategic alliances. *Administrative science quarterly*, 781-814.

Gulati, R., Wohlgezogen, F., & Zhelyazkov, P. (2012). The two facets of collaboration: Cooperation and coordination in strategic alliances. *Academy of Management Annals, 6*(1), 531-583.

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

Halaburda, H., Levina, N., & Semi, M. (2019, December). Understanding smart contracts as a new option in transaction cost economics. In *Proceedings of the 40th International Conference on Information Systems, Munich, Germany*. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3506223

Hart, P., & Saunders, C. (1997). Power and trust: Critical factors in the adoption and use of electronic data interchange. *Organization science*, *8*(1), 23-42.

Hopwood, A.G. (1996). Looking across rather than up and down: On the need to explore the lateral processing of information. *Accounting, Organizations and Society 21* (6): 589-590.

Håkansson, H. & Lind, J. (2004). Accounting and network coordination. *Accounting, Organizations and Society* 29 (1): 51-72.

ICAEW. (2017). Blockchain and the future of accountancy. Available at: https://www.icaew.com/en/technical/information-technology/technology/blockchain/blockchain-and-the-accounting-perspective.

Ireland, R. D., Hitt, M. A., & Vaidyanath, D. (2002). Alliance management as a source of competitive advantage. *Journal of management, 28*(3), 413-446.

Jensen, T., Hedman, J., & Henningsson, S. (2019). How TradeLens Delivers Business Value With Blockchain Technology. *MIS Quarterly Executive, 18*(4).

Kajüter, P., & Kulmala, H. I. (2005). Open-book accounting in networks: Potential achievements and reasons for failures. *Management Accounting Research, 16*(2), 179-204.

Klein, B., & Leffler, K. B. (1981). The role of market forces in assuring contractual performance. *Journal of political Economy, 89*(4), 615-641.

Kogut, B. & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science 3*(3):383-397.

Kokina, J., Mancha, R., & Pachamanova, D. (2017). Blockchain: Emergent industry adoption and implications for accounting. *Journal of Emerging Technologies in Accounting, 14*(2), 91-100.

Kornberger, M., Pflueger, D., & Mouritsen, J. (2017). Evaluative infrastructures: Accounting for platform organization. *Accounting, Organizations and Society, 60*, 79-95.

Kumar, K., & Van Dissel, H. G. (1996). Sustainable collaboration: Managing conflict and cooperation in interorganizational systems. *MIS quarterly*, 279-300.

Kumar, A., Liu, R., & Shan, Z. (2020). Is blockchain a silver bullet for supply chain management? Technical challenges and research opportunities. *Decision Sciences, 51*(1), 8-37.

Lacity, M. (2018). Addressing Key Challenges to Making Enterprise Blockchain Applications a Reality. *MIS Quarterly* Executive 17 : Iss. 3 , Article 3.

Litwak, E., & Hylton, L. F. (1962). Interorganizational analysis: A hypothesis on co-ordinating agencies. *Administrative Science Quarterly*, 395-420.

Luhmann, N. (1979). Trust and power. *John Wiley & Sons*.

Lumineau, F., Wang, W., & Schilke, O. (2020). Blockchain Governance—A New Way of

Organizing Collaborations?. *Organization Science.*

Luo, Y. (2002). Contract, cooperation, and performance in international joint ventures. *Strategic Management Journal 23* (10): 903-919.

MacLeod, W.B. (2007). Reputations, Relationships, and Contract Enforcement. *Journal of Economic Literature 45*, No. 3 (Sep., 2007), pp. 595-628.

Markus, M. L., Steinfield, C. W., & Wigand, R. T. (2006). Industry-wide information systems standardization as collective action: the case of the US residential mortgage industry. *MIS quarterly*, 439-465.

Mattke, J., Hund, A., Maier, C., & Weitzel, T. (2019). How an Enterprise Blockchain Application in the US Pharmaceuticals Supply Chain is Saving Lives. *MIS Quarterly Executive, 18*(4).

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of management review, 20*(3), 709-734.

McEvily, B., Perrone, V., & Zaheer, A. (2003). Trust as an organizing principle. *Organization science*, 14(1), 91-103.

Ménard, C. (1995). Markets as institutions versus organizations as markets? Disentangling some fundamental concepts. *Journal of Economic Behavior &* Organization 28 (2): 161-182.

Merchant, K. and Van der Stede, W. (2017). Management Control Systems. *Pearson*.

Murray, A., Kuban, S., Josefy, M., & Anderson, J. (2019). Contracting in the smart era: The implications of blockchain and decentralized autonomous organizations for contracting and corporate governance. *Academy of Management Perspectives*, (ja).

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. *Available at*: https://bitcoin.org/bitcoin.pdf

Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. (2016). *Bitcoin and cryptocurrency technologies: a comprehensive introduction*. Princeton University Press.

Nelson, P. (1970). Information and Consumer Behavior. *Journal of Political Economy 78*, No. 2 (Mar. - Apr., 1970), pp. 311-329.

Neumann, K. (2010). Ex ante governance decisions in inter-organizational relationships: A case study in the airline industry. *Management Accounting Research 21* (4): 220-237.

Nicolaou, A. I., Sedatole, K. L., & Lankton, N. K. (2011). Integrated information systems and alliance partner trust. *Contemporary Accounting Research, 28*(3), 1018-1045.

Nooteboom. B. (1992). Towards a dynamic theory of transactions. *Journal of Evolutionary Economics 2*(4):281-299.

O'Leary, D.E. (2017). Configuring blockchain architectures for transaction information in blockchain consortiums: The case of accounting and supply chain systems. *Intelligent Systems in Accounting, Finance and Management* 24 (4): 138-147.

Oliver, C. (1990). Determinants of interorganizational relationships: Integration and future directions. *Academy of Management Review 15* (2): 241-265

Olson, M. (1965). The Logic of Collective Action: Public goods and the Theory of Groups. *Harvard University Press*, Boston, 1965.

Ouchi, W.G. (1980). Markets, bureaucracies, and clans. *Administrative Science Quarterly*: *Vol. 25,* No. 1 (Mar., 1980), pp. 129-141.

Parkhe, A. (1993). Strategic alliance structuring: A game theoretic and transaction cost examination of interfirm cooperation. *Academy of Management* Journal 36 (4): 794-829.

Peters, G.W. &Panayi, E. (2016). Understanding modern banking ledgers through blockchain technologies: Future of transaction processing and smart contracts on the internet of money. In *Banking Beyond Banks and Money*: 239-278.

Pfeffer, J. & Salancik, G.R. (1978). The external control of organizations: A resource dependency perspective. *New York: Harper & Row*.

Poppo, L. & T. Zenger. (2002). Do formal contracts and relational governance function as substitutes or complements? *Strategic Management Journal* 23 (8): 707-725.

Poppo, L., Zhou, K. Z., & Li, J. J. (2016). When can you trust "trust"? Calculative trust, relational trust, and supplier performance. *Strategic Management Journal, 37*(4), 724-741.

Rauchs, M., Blandin, A., Klein, K., Pieters, G. C., Recanatini, M., & Zhang, B. Z. (2018). 2nd global cryptoasset benchmarking study. *Available at* https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/2nd- global-cryptoasset-benchmark-study/#.XVVxZ-gzb-g.

Rauchs, M., Glidden, A., Gordon, B., Pieters, G. C., Recanatini, M., Rostand, F., Vagneur, K. & Zhang, B. Z. (2018). Distributed ledger technology systems: A conceptual framework. *Available at*: https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/distributed-ledger-technology-systems/#.XkwjwihKj-h

Rauchs, M., Blandin, A., Bear, K., & McKeon, S. B. (2019). 2nd Global Enterprise blockchain benchmarking study. Available at SSRN 3461765. Available at: https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/2nd-global-enterprise-blockchain-benchmarking-study/

Reuer, J.J. & Ariño, A. (2007). Strategic alliance contracts: dimensions and determinants of contractual complexity. *Strategic Management Journal 28* (3): 313-330.

Reusen, E., & Stouthuysen, K. (2020). Trust transfer and partner selection in interfirm relationships. *Accounting, Organizations and Society, 81*, 101081.

Ring, P. S., & Van de Ven, A. H. (1994). Developmental processes of cooperative interorganizational relationships. *Academy of management review, 19*(1), 90-118.

Risius, M. & Spohrer, K. (2017). A blockchain research framework. *Business & Information Systems Engineering*. *59* (6): 385-409.

Rousseau, D. M., Sitkin, S. B., Burt, R. S., & Camerer, C. (1998). Not so different after all: A cross-discipline view of trust. *Academy of management review, 23*(3), 393-404.

Salvato, C., Reuer, J. J., & Battigalli, P. (2017). Cooperation across disciplines: A multilevel perspective on cooperative behavior in governing interfirm relations. *Academy of Management Annals, 11*(2), 960-1004.

Schepker, D. J., Oh, W. Y., Martynov, A., & Poppo, L. (2014). The many futures of contracts: Moving beyond structure and safeguarding to coordination and adaptation. *Journal of Management, 40*(1), 193-225.

Schelling, T.C., (1960). The Strategy of Conflict. *Harvard University Press*.

Schloetzer, J.D. (2012). Process Integration and Information Sharing in Supply Chains. *The*

Accounting Review 87 (3): 1005-1032.

Simcoe, T. (2012). Standard Setting Committees: Consensus Governance for Shared Technology Platforms. *American Economic Review* 102 (1): 305-36.

Smith, K. G., Carroll, S. J., & Ashford, S. J. (1995). Intra-and interorganizational cooperation: Toward a research agenda. *Academy of Management journal, 38*(1), 7-23.

Sobrero, M. and Schrader, S. (1998). Structuring inter-firm relationships: A metaanalytic approach. *Organization Studies 19* (4): 585-615.

Steinfield, C., Markus, M. L., & Wigand, R. T. (2011). Through a glass clearly: standards, architecture, and process transparency in global supply chains. *Journal of Management Information Systems, 28*(2), 75-108.

Stuart, T. E. (1998). Network positions and propensities to collaborate: An investigation of strategic alliance formation in a high-technology industry. *Administrative science quarterly*, 668-698.

Susarla, A., Holzhacker, M., & Krishnan, R. (2020). Calculative trust and interfirm contracts. *Management Science, 66*(11), 5465-5484.

Swanson, T. (2015). Consensus-as-a-service: A brief report on the emergence of permissioned, distributed ledger systems. *Available at:* https://allquantor.at/blockchainbib/pdf/swanson2015consensus.pdf

Szabo, N. (2017). Money, Blockchains, and Social Scalability. *Available at:* http://unenumerated.blogspot.com/2017/02/money-blockchains-and-social-scalability.html

Tasca, P. and Tessone, C.J. (2017). Taxonomy of blockchain technologies. Principles of identification and classification. *Available at:* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2977811

Telser, L.G. (1980). A theory of self-enforcing agreements. *The Journal of Business* Vol. 53, No. 1 (Jan., 1980), pp. 27-44.

Thambar, P. J., Brown, D. A., & Sivabalan, P. (2019). Managing systemic uncertainty: The role of industry-level management controls and hybrids. *Accounting, Organizations and Society, 77*, 101049.

Thompson, J. D. (1967). Organizations in action. *New York: McGraw-Hill*.

Trapido, D. (2007). Competitive embeddedness and the emergence of interfirm cooperation. *Social Forces 86* (1): 165-191.

Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly* 42 (1), 35-67.

Van de Ven, A.H. (1976). On the nature, formation, and maintenance of relations among organizations. *Academy of Management Review* 1 (4): 24-36.

Weiss, M., and Cargill, C. (1992). Consortia in the standards development process. *Journal of the American Society for Information Science* 43 (8): 559-565.

Werbach, K. (2018). The Blockchain and the New Architecture of Trust. *MIT Press*.

White, S. (2005). Cooperation costs, governance choice and alliance evolution. *Journal of Management Studies 42*(7): 1383-1412.

Williamson, O.E. (1983). Credible Commitments: Using Hostages to Support Exchange. *The American Economic Review* Vol. 73, No. 4 (Sep., 1983), pp. 519-540

Williamson, O.E. (1985). The economic institutions of capitalism. *The Free Press*, New York.

Williamson, O. E. (1991). Comparative economic organization: The analysis of discrete structural alternatives. *Administrative Science Quarterly* 36(2): 269–297.

Williamson, O.E. (1993). Calculativeness, Trust, and Economic Organization. *The Journal of Law and Economics 36* (1): 453-486.

Xu, X., Weber, I., Staples, M., Zhu, L., Bosch, J., Bass, L., Pautasso, C., & Rimba, P. (2017, April). A taxonomy of blockchain-based systems for architecture design. In *2017 IEEE international conference on software architecture (ICSA)* (pp. 243-252). IEEE. *Available at:* https://ieeexplore.ieee.org/document/7930224

Yermack, D. (2017). Corporate governance and blockchains. *Review of Finance* 21(1): 7-31.

Zajac, E.J. & Olsen, C.P. (1993). From transaction cost to transactional value analysis: Implications for the study of interorganizational strategies. *Journal of Management Studies 30* (1): 131-145.

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.

Zhu, K., Kraemer, K. L., Gurbaxani, V., & Xu, S. X. (2006). Migration to open-standard interorganizational systems: network effects, switching costs, and path dependency. *Mis Quarterl*y, 515-539.

Zhu, K., Kraemer, K., & Xu, S. (2003). Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors. *European journal of information systems*, *12*(4), 251-268.

Chapter 3: Paper 2: Standardization as collective action: Evidence from the Shipping Industry

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ABSTRACT

Business-to-business interactions are increasingly dependent on standards to support innovations in technology that drives the emergence of complex industry-wide solutions. Prior studies predominantly focus on technology standardization as a definite activity, in most cases explaining either the phase of standard development or standard diffusion, but not both. This limits the understanding of how technology standardization, seen as a continuous process including both phases of development and diffusion, evolves over time. We analyze two industry-wide standardization efforts in the container shipping industry, applying a collective action theory lens to understand the factors that influence standardization dynamics as they unfold over time. Our analysis identifies three critical collective action trade-offs that affect the standardization process: 1) flexibility vs inclusion; 2) generalizability vs completeness; 3) investment vs value capture. We discuss the implications of these trade-offs and offer theoretical insights about factors that influence collaborative standardization on an industry level. We further provide evidence and recommendations relevant for managerial decision-making of industry actors involved in complex technology standardization efforts.

Keywords: Standardization; Technology Standards; Collective action; Information systems; Platforms

1. Introduction

The complexity of modern technology, as well as its pervasiveness across all major industries which gives it a systemic character has led to a tremendous growth in the economic importance of technology standards over the last decades. More recently, technology standardization has assumed a vital role in supporting innovation in emerging economic trends (Wiegmann et al., 2017) such as complex systems and industry platforms (Saadatmand et al., 2019), novel technological solutions and related organizational forms such as blockchain technology (Kostić and Sedej, 2020) and ecosystems (Thomas and Ritala, 2021). Additionally, because such standards represent a form of technical infrastructure which exhibits characteristics of a collective good, they emerge from "reasoned, collective choice and enable agreement on solutions to recurring problems" (Tassey, 2000, p. 588). We study how and why organizations voluntarily engage in the process of technology standardization through collective action on an industry level. More specifically, we seek to explicate how a group of organizations can produce an industry standard through contributions to inter-organizational information infrastructure. The study is situated in the context of the container shipping and logistics industry (henceforth the shipping industry). Explaining how and why technology standardization efforts in the shipping industry emerge and evolve holds great theoretical and practical relevance considering the industry's centrality in global supply chains that are at the heart of much of the economic activity today.

Logistics in global supply chains represents a complex web of interrelations that entail simultaneous competitive and cooperative actions (Klein et al., 2007). Organizations constantly need to make decisions to safeguard their commercial interests while at the same time striving to facilitate mutual value creation through information exchange and process integration with industry partners (Schloetzer, 2012). These dynamics create systemic challenges on an industry level that no single organization can resolve on its own (Foray, 1994; Steinfield at el., 2011; Zhao et al., 2011). Consequently, a unique type of dependency develops between firms, where a resolution to these challenges can only arise through some form of collective action. Yet, how and under which circumstances such a broad group of legally independent organizations can successfully resolve industry-level challenges is far from self-evident. Significant inefficiencies in global supply chains are related to the flow of information across organizational boundaries. This is caused by the lack of a common information infrastructure and generally accepted standards for information exchange and trade documents (Jensen et al., 2019). Annual administrative costs in global supply chains, mostly caused by document processing, have been estimated to be about 22% of the retail cost of associated goods (Anderson and van Wincoop, 2004). Consequently, in spite of traditionally fierce competitive relations and often conflicting commercial interests among major actors in the shipping industry such as large ocean carriers, these actors are in agreement, albeit often tacitly, on at least one crucial common issue: they recognize the pressing need for more standardization-driven efficiency (Klein et al., 2007; Steinfield et al., 2011; Jensen et al., 2014; Jensen et al., 2019; Voorspuij and Becha, 2021). These actors have nevertheless repeatedly failed to address this universally agreed-on common interest. Governmental (EU) and standard-setting bodies (ISO and ANSI) developed and sponsored several standards that have since been made publicly available (Jensen et al., 2019, p. 224). However, these have been only partly adopted by some global supply chain actors in spite of significant institutional support on an international level. The absence of collective action in standard-making might arise because organizations face a multiplicity of interests, some of which are conflicting, and as such lower the likelihood of collaboration on achieving a broader common goal (Markus et al., 2006; Thambar et al., 2019). To shed new light on this complex issue, our study addresses the following research question: How does a process of technology standardization through collective action on an industry level arise and evolve?

We define technology standards as technical specifications that describe data formats and protocols for computer communication, which are therefore seen as the "blueprint" for the interaction patterns between organizations (Zhu et al., 2006; Zhao and Xia 2014; Christ and Nicolaou, 2016). Additionally, in line with Olson (1965), we frame a technology standard as an *inclusive collective good*. Collective because it is not economically feasible to prevent any of the members of the group[23] from consuming the good, irrespective of the size of their contributions to its attainment, and inclusive because consumption of the good by new members of the group results in little or no reduction in consumption of the existing members (Olson, 1965). When discussing technology standardization, it is important to note that a particular solution (e.g. an information exchange system) itself is not the good, rather the good is the functionality that the information system affords for the participating organizations (Monge et al., 1998). This means

[23] In this context, a "group" broadly refers to an assemblage of organizations that serves to further the common interests of its members. For the purposes of this paper, we consider *inclusive groups* of organizations as defined by Olson (1965). When there is organized or coordinated effort in inclusive groups, as many organizations as can be persuaded to participate will be included in the effort. A specific characteristic of inclusive groups is that it is not essential that every member participates in governance or decision-making. Consequently, an inclusive collective good produced by these efforts is by definition such that the benefit of a noncooperator is not matched by corresponding losses to those that do cooperate (Olson, 1965).

that general insights can be derived from more than one case where different solutions offer participating actors functionalities comparable in nature. On the other hand, Wiegmann et al. (2017) remind us that functional attributes of standards have an important effect on both the stakes and the characteristics of actors involved in standardization, meaning that standardization efforts exhibit case-specific dynamics and interactions. Therefore, to generate theoretical insights and understand how these dynamics and interactions play out, it is necessary to consider and analyze the participating actors, their interests (Markus et al., 2006), and the strategies they apply to attain those interests (Wiegmann et al., 2017) over time. This calls for an approach where technology standardization is seen as a process in which the development of standards and their subsequent diffusion do not represent mere sequential steps, but are mutually related (Botzem and Dobusch, 2012). Further, according to the process perspective (Wiegmann et al. 2017), an established standard represents an equilibrium reached between the involved parties, which may be short-lived, and is therefore not seen in the analysis as a definitive end point to a standardization process. We take a process perspective to examine how technology standardization efforts develop and evolve over time, and what the crucial factors are that influence their trajectories. To explain these issues, we analyze two collaborative technology standardization endeavors in the container shipping industry. We apply a collective action theory lens to invoke explanations for factors that influence how the process of technology standardization occurs and unfolds in an inter-organizational setting, and in the absence of an external standard-setting body with the authority to mandate the use of the standard and steer consensus-seeking among members. Further, we put particular emphasis on the multiple and interdependent dimensions of collective action among actors and delineate our findings through three novel collective action trade-offs.

Research has long recognized that technology standards play a prominent role in facilitating operations of firms, especially inter-organizational communications (Markus et al., 2006; Bala and Venkatesh, 2007; Zhao et al., 2011). Traditionally, technology standardization literature has focused on examining standardization efforts resulting in winner-take-all scenarios in the market (David and Greenstein, 1990; Chiao et al., 2007), or efforts sponsored by regulatory (Ferrell and Shapiro, 1992) or international standard-setting bodies (Chiao et al., 2007; Leiponen 2008; Simcoe, 2012). However, over the past decades, driven by industry needs and technological advances, organizations have increasingly leveraged industry partners' resource contributions and engaged in collaborative standardization efforts driven by private actors (Foray, 1994; Zhao et al., 2011; Narayanan and Chen, 2012). Collaborative efforts in the context of technology standardization include committee, consortia and alliance-like structures (Wiegmann et al., 2017). They are understood here in line with Weiss and Cargill (1992) as a collection of like-minded interests that participate in what may be a market accepted solution to what is perceived to be a common problem.

Research in technology standardization predominantly focuses either on standard development (Weiss and Cargill, 1992; Leiponen, 2008; Uotila et al., 2017), or standard diffusion (Weitzel at al., 2006; Zhu et al., 2006), with only a few empirical studies considering both phases simultaneously (Markus et al., 2006; Botzem and Dobusch, 2012 being notable examples). In other words, the existing literature has adopted a somewhat fragmentary approach to analyzing technology standardization. It therefore lacks insights about how the factors involved in development and wide adoption of the standards interrelate within and between the two phases, which further limits our understanding of standardization as an ongoing process. This is important because, as Wiegmann et al. (2017) observe, the ongoing nature of technology standards lies not only in the need for updates to their technical attributes, but also in the temporal variability of the level of interest in standard provision and the ability and willingness of actors to contribute resources to the standardization efforts. This is particularly salient for collaborative standardization efforts that are predominantly driven by legally independent organizations, which due to strategic considerations may seek to challenge an already established standard (Wiegmann et al., 2017).

Collective action theory (Olson, 1965; Marwell and Oliver, 1993) maintains that a group which has members with highly unequal degrees of interest in the collective good, where one or a few members deem the collective good extremely valuable in relation to the costs of its provision, will be more apt to provide the collective good than would be some other group with the same number of members. Earlier studies highlight heterogeneity of interests and resources of a wider population of participants as impediments for both standard development and diffusion (David and Greenstein, 1990; Markus et al., 2006). We show that this heterogeneity might actually be beneficial for the standardization effort by considering the extent of participants' interest in providing a standard, as well as the pattern of interrelations among the "critical mass" of especially interested and resourceful members (Marwell and Oliver, 1993) of the group of organizations engaged in standardization.

We extend earlier work of technology standardization scholars by empirically identifying and delineating three novel collective action trade-offs that dynamically affect the process of standardization: (1) flexibility vs inclusion, (2) generalizability vs completeness, and (3) investment vs value capture. We show that these trade-offs exhibit strong mutual interrelations and embody crucial design and governance choices made by the relevant actors throughout standardization processes in the two examined cases. We empirically develop our arguments through in-depth case studies of two unique projects in the shipping industry established at different points in time, namely INTTRA and TradeLens. The cases of INTTRA and TradeLens are illustrative because both of these initiatives represent attempts to address an industry-wide technology standardization problem by developing platforms intended to represent common information infrastructures, and collectively agreeing on standards to underpin those infrastructures, albeit with crucial differences in their respective approaches.

2. Technology standardization on an industry level: a collective action theory perspective

To make sense of the complexity and dynamics of the process of industry level technology standardization we rely on Olson's theorizing on the logic of collective action (Olson, 1965), as well as the work of other collective action scholars such as Marwell and Oliver (1993) and Hardin (1982). A common view among collective action scholars is that factors such as actors' level of interest in the collective good, resource availability and group composition have a significant effect on the provision of collective goods. Further, collective action theory maintains that collective goods such as industry standards are defined with respect to a specific group, where some goods are collective goods to those in one group, while at the same time being private goods to those in another because some organizations can be prevented from consuming them, and others cannot (Olson, 1965). To elaborate on the relationships between different types of groups and the nature of the collective goods they produce, Olson (1965) stresses that the choices related to the structure and governance of the group depend importantly on the "supply" of the benefits accruing from the collective good. With *inclusive* groups, the "supply" of the benefits from the collective good automatically expands as the group expands, a representative example of such a good being an industry standard (Olson, 1965). Inclusive collective goods are such that they are characterized by at least a considerable degree of jointness of supply[24], meaning that additional members of the

[24] A good has "jointness of supply" if making it available to one individual organization means that it can be easily or freely supplied to others as well (Olson, 1965).

group can enjoy the good with little or no reduction in consumption of the existing members (Olson, 1965). Although, importantly, exclusion of consumption *within* the group is economically infeasible.

In analyzing whether or not a collective good such as an industry standard will be provided, it is necessary to consider not only the structure of the group with a common interest in providing the good, but also the structure and the degree of interest in the collective good among the group's members. A group with inequality in the degree of interest in the collective good[25], is more likely to provide the good (Olson, 1965). While Olson argued that this scenario is most likely in smaller groups, Hardin (1982) and Marwell and Oliver (1993) extend Olson's arguments and show that with a good that enjoys a considerable degree of jointness of supply, and in a group characterized by inequality of interests, the good that benefits many others will be provided even in a large group thanks to especially interested and resourceful members. These members are referred to as the "efficacious subgroup" and "critical mass" by Hardin (1982) and Marwell and Oliver (1993) respectively. Echoing Olson's argument about inclusive collective goods, Marwell and Oliver (1993) show that when a good has jointness of supply, it is largely irrelevant to the benefits of those who contribute to the provision of the collective good how many other members there are who might also contribute. What matters here, as Marwell and Oliver (1993) argue, is the pattern of relations among the contributors in the "critical mass", not the relations among everyone in the larger group with a common interest in the collective good.

3. Standard development and standard diffusion

The literature has recognized that industry-wide benefits from technology standardization depend on two sets of factors: (1) successful development of standardized business grammars, processes, and protocols, and (2) successful diffusion of these standards and their subsequent adoption by firms, regardless of their size (Markus et al., 2006; Zhao and Xia 2014). These sets of factors have been broadly classified as two distinct collective action dilemmas: (1) the dilemma of standards development (Weiss and Cargill, 1992; Foray, 1994; Cargill, 1997; Uotila et al., 2017), and (2) the dilemma of standards diffusion (Kindleberger, 1983; Weitzel et al., 2006; Zhu et al., 2006).

[25] The greater the interest in the collective good of any single member, the greater the likelihood that this member is expecting to gain a portion of the total benefit from providing the collective good sizeable enough to justify possibly disproportionate costs to this member necessary to provide the good (Olson, 1965).

Several studies have applied the collective action lens to the study of collaborative technology standardization in several industry settings such as the mortgage industry (Markus et al., 2006), road haulage industry (Saadatmand et al., 2019), and insurance, health care, and high technology industry (Keil, 2002; Zhao et al., 2011). This approach to industry standardization emphasizes collective action to achieve the goals of harnessing resources and capabilities of a relatively broad set of industry actors while co-opting their competitive impulses, reducing the appropriability of the developed standard, and encouraging broad interconnectivity between parties (Foray, 1994; Keil, 2002). Markus et al. (2006) examine vertical information systems (VIS) standardization and challenge the conception that technology standardization can be fully understood by analyzing either standard development or standard diffusion in isolation, arguing instead that successful standardization efforts must include a heterogeneous group of both vendors and users without fragmenting, thereby solving both standardization dilemmas simultaneously. In their examination of the theoretical basis for the emergence and classification of standard-setting consortia, Weiss and Cargill (1992) argue that, due to network externalities and the collective-good nature of standards, consortia and alliances that seek to establish standards should be considered an inclusive group in Olson's terminology. The reason is that, while there may be heterogeneity in interests and resource contribution among members, a strong incentive exists for such alliances to expand the membership pool as much as possible, as this may cause a bandwagon effect to form around the standard, leading to its adoption by the wider market (Farrell and Saloner, 1985).

In discussing standard development, Greenstein (1992) argued that, in comparison to standards promoted by dominant vendors, standards set by consortia of organizations are more likely to attract support by buyers and other vendors in the market. Such standardization consortia arise when actors share a common interest in developing and promulgating standards, but structural impediments prevent any single firm from sponsoring a standard that the others will adopt (Greenstein, 1992). Standards development consortia have an incentive to include all participants with a compatible preference structure in order to maximize the potential size of the standard adopter population. As Weiss and Cargill (1992) observe, this particularly refers to large firms that may have an outsized influence on others to adopt the standard. Furthermore, Farrell and Saloner (1988) suggest that combining resources and competencies of participant organizations with a compatible preference structure may mean that coordination within the consortium is easier to achieve. However, West (2006) cautions that when the number of actors involved becomes too large, it can become challenging to accommodate diverging interests of vendors who prefer proprietary solutions, and users who prefer more open solutions.

Studies have claimed that the difficulty in creating a viable alliance to develop and promote an industry standard is that, in the absence of a standard setting authority that would mandate its use or a coordinating body to steer consensus-seeking among members (Markus et al., 2006; Zhao et al., 2014), there are limited incentives for an individual actor to take part in the development and negotiation process when a technical solution for a standard is being formulated (Foray, 1994). The reasoning behind these claims is that the effects of technology standardization (i.e. compatibility and interoperability) can have the nature of a collective good when introduced on an industry level (Kindleberger, 1983). However, as Marwell and Oliver (1993) and Olson (1965) show, in such a situation, when a collective good has a significant degree of jointness of supply, it is not the relations between all participants in the wider group that might benefit from the good that matter, but rather the relations among the participants with the highest level of interest in the good, or the "critical mass" in Marwell and Oliver's terminology.

Many authors treat collective goods as being by definition plagued by the "free-rider problem" (Kindlberger, 1983), consequently making non-participation appealing to some actors. However, Marwell and Oliver (1993) argue that in situations where successive contributions to the attainment of a collective good yield progressively greater rewards, free-riding is not the crucial dynamic. Take for example an industry wide standardized information exchange infrastructure. The first organizations that introduce a new standardized system benefit only from direct linkages with each other, while incurring potentially very high start up costs. In such a situation it is difficult to initiate collective action because the benefits to early contributors are largely contingent on the subsequent contribution of others, be it through direct investments, granting access to data or facilitating connections with additional partners (Monge et al., 1998). Additionally, in the early stages of a standardization process, it is not clear to potential adopters what those benefits will be, both in their level and nature (Monge et al., 1998). Thereby, their interests in supporting the effort are of a dynamic nature, and may grow over time as the benefits of using the solution become more apparent (Browning et al., 1995; Monge et al., 1998). Ultimately, however, the best assurance and proof of intentions lies in other organizations' actual adoption of a standard. Thereby the tendency is often to wait for others to adopt first. This effect has been termed differently in the literature as an assurance game (Kollock, 1998) or penguin effects (Weitzel et al., 2006). The practical implication of this effect is that standard diffusion tends to be slow and uncertain (Markus et al., 2006).

In summary, based on the review of literature on technology standardization we have a developing understanding of how the factors such as the free-rider problem and heterogeneity of interests among different types of participants (i.e. users and vendors) influence standard development and standard diffusion on an industry level. It is however less clear how the two phases of standardization can be addressed simultaneously. Furthermore, it remains largely unknown how standardization evolves over time, and how this process is affected by heterogeneity in the level of interest in the standard among participating organizations, where some could be both more willing and able to contribute to the process of standardization. Further still, it remains unknown how the effects of those factors vary over time, and what could be the causes of the changes. We leverage a combination of theoretical arguments about the importance of the inequality in the degree of interests within the larger group of organizations seeking to establish a technology standard, and the pattern of relations among a smaller critical group of highly interested and resourceful organizations, and study how these factors dynamically affect the process of technology standardization on an industry level.

4. Research design

The purpose of this study was to examine the process of technology standardization on an industry level, and identify crucial factors and dynamics related to it. The unit of analysis in our research question is the process of technology standardization, an industry level phenomenon (Markus et al., 2006). In order to answer our research question, we collected data on two technology standardization attempts in the shipping industry, namely INTTRA and TradeLens, that appeared to be uniquely suited to our study's objectives. Although created at different points in time, the two projects espouse a comparable goal, that of creating a technology standard for improving information exchange in the shipping industry. Our multiple case study approach allowed us to generate rich, field-based insights (Gioia et al., 2013) into how technology standardization processes on an industry level occur and unfold. The case study method is particularly suitable for exploring phenomena which cannot easily be separated from the context in which they occur (Yin, 2009). Empirical evidence, derived from observing real-life cases can also help identify new facets and aspects derived from reality (Yin, 2009). We opted for a qualitative study, as qualitative data provides rich, well-grounded descriptions, and can describe processes in identifiable local settings (Miles and Huberman, 1994). This type of data, however, can raise concerns related to credibility of conclusions, data overload and generalizability. As such, the way in which qualitative data is collected and analyzed must be methodical and systematic (Miles and Huberman, 1994; Collis and Hussey, 2013). We attempted to mitigate these concerns by joint interviews, reviewing the results of the coding process between authors, asking respondents to review and provide clarification of interview transcripts and adhering to a systematic and methodical process.

During data collection, it became apparent that even though numerous attempts at creating technological standards have been made in the past (e.g. INTTRA, GT Nexus[26], CargoSmart[27]), they have been only partially adopted by the actors in the shipping industry. At the same time, there seemed to be an overarching consensus among our respondents that common technology standards in the shipping ecosystem would bring about massive efficiencies for all parties involved. To address this apparent paradox, we focused our attention on exploring two sets of factors: (1) factors influencing standard development, and (2) factors influencing standard diffusion, and analyzing how these factors interrelate between the two phases of the standardization process. Based on the analysis of collected data, we found the literature on collective action to be particularly promising for the analysis of our cases. Because standardization efforts in the shipping industry invariably involve coordinated action between industry rivals, this theoretical lens seemed especially useful for explicating the different aspects of standardization in these settings. Additionally, the literature on technology standardization through collective action addresses two sets of factors we were particularly interested in, namely standard development (e.g. Cargill, 1997; Uotila et al., 2017) and standard diffusion (e.g. Kindleberger, 1983; Weitzel et al., 2006; Zhu et al., 2006).

4.1. Data collection

We employed field-based research methods to capture rich evidence of factors influencing technology standardization efforts in the shipping industry. We collected data from several sources: (1) in-depth semi-structured interviews; (2) participation at industry events; (3) informal talks with experienced individuals from the shipping industry; and (4) secondary data including

[26] For more information see: https://www.gtnexus.com/
[27] For more information see: https://www.cargosmart.com/en/default.htm

INTTRA's and TradeLens' documentation, industry reports and other practitioner oriented literature such as books, industry conference presentations, news articles and press releases.

Interviewees were selected based on their roles within their respective organizations and their involvement in either TradeLens or INTTRA. Whenever possible, we selected interviewees that were involved in both projects. The examples of respondents that were involved in both initiatives include interviewees from large ocean carriers (Mærsk and MSC[28]), a large customer experienced in using INTTRA and piloting TradeLens (AB InBev) and a prominent shipping industry analyst (SeaIntelligence Consulting), who was also a former Mærsk representative at INTTRA. Some of the other respondents were only involved in TradeLens (e.g. IBM, YILPORT holding, GCT terminals, Youredi), but were nonetheless able to provide valuable insights on the pertinent issues of technology standardization in the shipping industry. Our interviewees held senior positions within their organizations (e.g. CEO, CIO, CTO, VP, Head of Department). We chose respondents in senior positions because they are be able to provide a high-level view of the most important decisions related to standard development (i.e. what are their most important requirements when developing a standard), as well as standard diffusion (i.e. what would it take for them to adopt a standard). These respondents were also in a position to discuss important strategic considerations of their respective organizations at different points in time. Interviews were recorded and transcribed verbatim. Additionally, we took very detailed notes during and immediately following the interviews.

The data collection spanned from May 2018 to September 2020. Initial exploratory interviews were conducted at Mærsk in 2018, in order to understand the development process of TradeLens. During this phase of data collection, we learned about INTTRA, another attempt at standardization in the industry, which went live about 20 years before TradeLens. Although INTTRA initially seemed to work well, it never reached anticipated levels of diffusion and managed to become an industry standard. At the same time, our findings suggested that TradeLens was struggling with industry-wide diffusion. Consequently, we became interested in decisions involved in development of both platforms, as well as the reasons that could explain why INTTRA was not able to diffuse more widely, and why TradeLens was struggling with adoption. In turn, the questions regarding development choices and their impact on subsequent diffusion were

[28] The Chief Digital and Information Officer (CDIO) of MSC was also a chairman of INTTRA for nearly 18 years, and was able to provide information on both projects

included in our interview guide for the next round of interviews, conducted during 2019 and 2020. Appendix A provides an overview of the interviews conducted.

Apart from the formal interviews, we held several informal talks with individuals knowledgeable about the shipping industry, and standardization efforts more broadly. These include the CEO and Statutory Director of Digital Container Shipping Association (DCSA[29]), a standard-setting body, and a MIT Sloan Distinguished Professor of Management, who has published extensively on the formation of voluntary consensus standards, primarily in the U.S. In addition to the interviews and informal talks, we collected data by participating in industry conferences and live webinars[30]. Appendix B maps these events.

We were attentive to the data quality issues, which may arise because the two projects were carried out at different points in time. While INTTRA has been operational for nearly two decades, TradeLens could be considered a standard in the making. That meant that while we were able to collect data on how INTTRA's initial and subsequent diffusion unfolded, we are unable to evaluate with certainty whether TradeLens will ultimately become an industry standard. In addition, INTTRA has been sold to E2Open[31], a provider of cloud-based software solutions in 2018, and it is unclear how the platform will develop in the future. We tried to minimize these concerns by focusing our attention on the choices made during INTTRA's initial development and diffusion, which are comparable to phases TradeLens was going through during the course of data collection. Additionally, these concerns were mitigated through our conceptual approach, where standardization is understood and framed as an organized and ongoing process of sequences of standard development and diffusion (Botzem and Dobusch, 2012; Wiegmann et al., 2017). When conducting interviews, we encouraged respondents to describe both the initial steps taken during the development of both platforms, as well as how these decisions impacted diffusion and vice versa. Where relevant, we also asked informants to compare and contrast both projects. To mitigate retrospective bias, we carefully focused on the most material events during the standardization process (Jovanović et al., 2021; Miller and Salkind, 2002). Moreover, we used archival data to identify main factors and milestones during the phases of development and diffusion of both platforms. To verify our findings and interpretations, we conducted repeated

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[29] For more information see: https://dcsa.org/

[30] Live webinars and virtual conferences replaced live industry events in 2020 and 2021 due to the COVID-19 pandemic

[31] For more information see https://www.e2open.com/

interviews with a Digital product manager at Mærsk. Repeated interviews also allowed us to cross check information collected from other respondents and secondary data. Inconsistencies found between primary and secondary data further guided our data collection and analysis. Secondary data used in this study include INTTRA's and TradeLens' documentation, industry reports, industry conference presentations, news articles and press releases. An overview of secondary data sources can be found in Appendix C.

4.2. Data analysis

We followed a thematic analysis approach to interpret our data. Thematic analysis provides means to identify patterns in complex sets of data (Braun and Clarke, 2006) and accurately recognize empirical themes grounded in the context of case study (Jovanović et al., 2021).

We began our analysis by reading and re-reading the interview transcripts, and highlighted the most common words and phrases. Where possible, we tried to corroborate the interview data with secondary data. This process involved a constant comparative method, where new data was constantly compared to prior data in terms of categories and hypotheses (Browning et al., 1995). This process was repeated, until theoretical saturation was reached, meaning that no new categories were emerging from the data (Strauss and Corbin, 1990; Glaser and Strauss, 2017). Initial coding produced fifteen first level codes pertaining to factors that influence standardization efforts. We then further examined identified themes to find links and patterns between them (Gioia et al., 2013). Subsequently, these codes were aggregated into three high-level themes. We then iterated between emerging findings and relevant literature, to determine whether our analysis yielded novel concepts (Corley and Gioia, 2011; Dattée et al., 2018). Consequently, we combined concepts from extant literature with our findings (Dattée et al., 2018) to propose three novel collective action trade-offs, which were found critical to standardization efforts. We constructed our narratives for each of the identified trade-offs and included selected quotations from interview transcripts to illustrate our findings. These narratives form the analytical scaffolding for the findings presented in this study. Before presenting our findings, we provide a short overview of both cases.

5. Background of INTTRA and TradeLens

INTTRA was founded by a consortium of the world's largest ocean carriers[32] in the early 2000s. Its aim was to create an information infrastructure encompassing an EDI-based information exchange platform that supports standard electronic bookings for the ocean freight industry. A catalyst for creating INTTRA was the rise of the internet. One of our respondents, a former Mærsk representative at INTTRA, noted: "*INTTRA was created during the dot-com bubble. Carriers were afraid someone else would build a portal. And if that becomes successful, whoever owns that portal, suddenly owns the customer relationship. That would be disastrous for carriers. So a number of carriers got together and said: "Fine, if that's the threat, let's build a portal ourselves"*". The initial idea behind INTTRA was to create a "hub-and-spoke" solution, which would simplify the container booking process, as customers would only need to set up and maintain a single EDI connection (i.e. with INTTRA), instead of having to manage separate EDI connections with several different ocean carriers. INTTRA's ambition was also to standardize shipping instructions and eventually move to standardizing other documents, which would ultimately create value for the entire shipping industry. As a former member of INTTRA's board of directors recalls: "*The idea there [behind INTTRA] was to bring some collaboration between the carriers,[...] to try to bring some standards to the basic shipping transactions. And so we did that, but it was really limited to the technology side. Let's create some EDI messages. Let's try and talk the same language, use the same codes*". About 5 years after its inception, INTTRA was processing roughly 28% of global container bookings. By 2008, however, platform development reached an impasse. To move forward, INTTRA needed to adjust and expand its product offering, which would both satisfy the needs of its existing clients, as well as attract new ones. However, the efforts to further develop the product offering were crippled by INTTRA's ownership and governance structure—where each carrier held veto rights—and further exacerbated by financial difficulties caused by the 2008 financial crisis. Although INTTRA is still used for creating roughly 25% of global container bookings, our respondents repeatedly noted that the platform was ultimately unable to live up to its envisioned potential of becoming an industry standard.

TradeLens is a more contemporary attempt at creating a common information infrastructure, launched in early 2018. It is a supply chain platform, underpinned by blockchain technology, and

[32] INTTRA's founding members were Maersk Line, Mediterranean Shipping Co., CMA CGM, Hamburg Sud, Hapag-Lloyd and United Arab Shipping Co.

jointly developed by Mærsk and IBM. TradeLens was designed to decrease transaction costs, allow secure exchange of inter-organizational information and create transparency across global supply chains. In practical terms, TradeLens has a broader scope than INTTRA, which entails that it is aimed at integrating a population of partners that is both more diverse (i.e. also including ports and terminals, intermodal operators, customs authorities, financial service providers), and more numerous compared to the shipper-carrier oriented INTTRA. After announcing the platform, Mærsk and IBM initially envisioned it as a joint venture between the two firms. This idea was quickly met with resistance from rival ocean carriers, who did not want to share their data through a platform created by one of its biggest competitors. Consequently, Mærsk and IBM moved away from the initially planned joint venture, and positioned TradeLens as a loose collaboration between the two companies. Additionally, the TradeLens advisory board was established with the aim of ensuring that the decisions regarding platform development are transparent and aligned with other ecosystem members. Although the advisory board has no formal decision-making power, it provides a channel for ecosystem members to influence the future technical and governance direction of TradeLens (Jensen et al., 2019).

6. Trade-offs

Companies engaging in collective action to create technology standards are likely to have diverging interests regarding the standardization process. Based on the analysis of collected data, we identify three trade-offs: (1) flexibility vs inclusion, (2) generalizability vs completeness, and (3) investment vs value capture that were found critical for the standardization processes in the examined cases.

6.1. Flexibility vs Inclusion

Flexibility vs inclusion refers to the number and type of actors involved in the standardization effort. It represents a trade-off between focusing on flexibility and speed in decision-making by involving only a small number of actors with a high level of available resources and interest in standard provision, and the inclusion of additional stakeholders that would provide additional credibility to the standardization effort and expand the potential size of the adopter population. A number of interviewees noted the relevance of this trade-off, although different respondents advocated different approaches to how it can be addressed. The Digital product manager at Mærsk, for instance, highlighted the benefits of flexibility: "*Driving a new product or a new offering by a few strong partners is not a problem […] because someone has to bring it to life.*

And maybe that's easier with few select parties who really want to drive that agenda, as compared to saying to the world:"Let's build something brilliant, who wants to join?". Then you end up in endless discussions about this or that feature". Global Head of Integration at APM Terminals, on the other hand, emphasized the need for inclusion: "*Big customers such as IKEA, Nestle, use many different carriers, so they drive standards along with the carriers. The odds of success are higher if you engage stakeholders from the beginning*".

While excluding a broader variety of stakeholders from the standard development phase may allow for higher flexibility and speed in decision-making, it can also hinder subsequent diffusion, as requirements of other relevant actors may not be met by the proposed solution. An example was given by Chief Digital and Information Officer (CDIO) of the Mediterranean Shipping Company (MSC): "*If we use a standard that we've agreed [only] between us... It's basically not a standard, it's proprietary. So standards are created by adoption. Nothing else. Either by an option or because you have no choice. The difficulty is that if you take the shipping industry and you draw the supply chain [...] you'll see [that] there's a lot of partners. So of course, as a shipping line, we're only a portion of that supply chain. Therefore, whatever we agree between ourselves is not sufficient. And then when you try to attract other parties, it's quite, quite complex, because everybody has an interest*".

Even though both INTTRA and TradeLens espoused comparable goals of eventually becoming a standard in the shipping industry, the two initiatives started on the opposite ends of the flexibility/inclusion spectrum. While INTTRA was started by some of the world's largest ocean carriers, TradeLens was started by only one carrier, albeit the largest (Mærsk), and a technology provider (IBM). INTTRA's foundational contract stated that every ocean carrier can only have one vote in the decision making process, and could only hold up to 25% of the ownership shares of the platform. The contract further stated that each member carrier held veto rights on decisions regarding the platform's development. By 2005, however, Mærsk held 65% of the ownership shares of INTTRA[33], which the company accumulated over time through acquisition of other ocean carriers. Despite holding the majority of INTTRA's ownership shares, the governance model still treated Mærsk as a single carrier, meaning that it only carried a single vote. Former Mærsk representative at INTTRA highlighted the governance issues as one of the main

[33] A.P. Møller - Mærsk A/S Annual report 2005
https://investor.maersk.com/system/files-encrypted/nasdaq_kms/assets/2012/06/14/4-20-39/Annual_2005_uk.pdf

impediments to INTTRA ultimately becoming a true industry standard: "*At some point, Mærsk owned 65% of INTTRA. Since it could only sell [shares] to other carriers, no one wanted to buy. But despite having 65% it still got only one vote. INTTRA missed the boat. Because of the ownership structure between carriers, it was impossible to achieve anything*". This was just one glaring example of governance issues that have hindered the continuous development of INTTRA. Another challenge came with the financial crisis in 2008, when monetary concerns overshadowed the discussions regarding further updates and extensions to the standard that would accommodate emergent industry needs. As a former member of INTTRA's board of directors recalls: "*Then came 2008, and there was a big crisis. And in 2008 INTTRA ran out of money. And the carriers didn't have money to put back in the venture. And the board meetings we were having were all about money and revenue, but not about products. And so for many years we didn't develop the products. I think everybody was trying to continue to sell the same products or maybe to bring some new products, but nobody could agree on how to do that*".

In contrast, TradeLens was initiated by a single ocean carrier, and a technology provider. In that sense, Mærsk and IBM had the flexibility to quickly proceed with the development phase, but concurrently ran into problems with the diffusion of their solution. In mid-2018, this meant that Mærsk and IBM were struggling to convince other ocean carriers to join their platform. Rival industry players cited the rights to intellectual property to which Mærsk and IBM have full and equal claim as the main impediment to joining TradeLens, with some going as far as labelling TradeLense as "unusable" (Allison, 2018). The decision to develop a solution without the initial involvement of other ocean carriers was described by the Vice President of Blockchain Solutions at IBM. Similarly to several others, this interviewee implicitly pondered the trade-off between flexibility and early inclusion: *"Now, one of the big lessons that I learned is, in retrospect, maybe we should have gotten the buy-in from the top six carriers upfront before building the platform, because [there is] a lot of delay in trying to bring the ecosystem together […] However, somebody has to build a platform, [and] it's always easier to build a platform with a small group rather than with a committee of 10 or 12. But you've got to talk about the platform and get some buy-in before engaging. Otherwise, here right now, we go through many challenges trying to explain why we made certain decisions in building the platform".* After facing problems to attract crucial partners TradeLens moved away from the initial joint venture structure, establishing a third-party entity, called GTD Solution in order to limit the level of control Mærsk had over the platform. Furthermore, the TradeLens Advisory Board was established with the dual aim of incorporating inputs from a diverse set of industry actors which would thereby partly shape the continuing development of TradeLens, as well as building on the benefits of higher inclusion to drive the diffusion. In essence, our findings suggest that the trade-off between flexibility and inclusion entails the necessity of developing the ability to harness market forces to the standardization process (Jain, 2012) while simultaneously preserving control and decision-making benefits of narrower committee-like structures involving key standard sponsors.

6.2. Generalizability vs Completeness

The trade-off between generalizability and completeness refers to the extent and specificity of standardization solutions. In other words, a technology standardization effort needs to strike a crucial balance. This involves, on the one hand, developing a solution that is technically complete enough for there to be a sufficient level of compatibility between parties to establish a common information infrastructure. On the other hand, it requires keeping the solution sufficiently "system agnostic" for it to be generalizable enough to diffuse sufficiently to become an industry standard. Because actors involved in collective action often have diverging interests, including commercial considerations, often only "incomplete standards" can be agreed upon.

INTTRA started with a narrow scope. It was initially designed for moving shipping instructions between customers and ocean carriers. Despite having to deal with many regulatory requirements, INTTRA was successful in standardizing basic shipping instructions. The problems arose when, due to customer requirements, certain ocean carriers wanted to upgrade INTTRA and make it more complete. Attaining higher levels of completeness, however, required both additional resources as well as for ocean carriers in charge of INTTRA to reach an agreement on the extent of the upgrades. This presented a problem because some ocean carriers failed to recognize the value from further investment in the development of INTTRA. Former Mærsk representative at INTTRA described these developments: "*The issue with INTTRA…they had standard electronic shipping instructions. But as the world developed, customers wanted to have added data fields, and needed to upgrade the standard. Then they ran into problems, as individual carriers didn't want to spend time and resources on that. Other carriers did it, and they ended up with customized solutions for customers*". This respondent further suggested that INTTRA plateaued because it failed to expand its offerings to address the needs of smaller clients in the market in particular, which have traditionally been catered to by the freight forwarders: "*INTTRA was a way to make it easier to maintain EDI connections. For large customers, it is much simpler to maintain one*

EDI connection [with INTTRA], instead of 20 [with each ocean carrier]. But that also means that only ones with EDI connections were large customers. Once that was up and running, INTTRA maxed out. Then you end up with a tool that means nothing to small guys. And that is a problem. Because the uptake in digital transformation is the largest with small and medium-sized customers. It is very expensive to serve little customers. But at the same time, small customers pay much higher freight rates. If you exclude smaller customers, then you are losing a lot of potentially most profitable sales".

In comparison, TradeLens started with a broader scope. The platform aims to both connect the entire shipping ecosystem, as well as digitize a plethora of relevant trade documents such as the bill of lading, packing list, and certificate of origin. As such, TradeLens was, by design, intended as a more complete solution than INTTRA. Respondents noted that engaging the entire ecosystem is a way to improve operational efficiencies for a number of actors within the industry. Vice President of Blockchain Solutions at IBM, for example, emphasized that such an approach can create value for customers that cooperate with several ocean carriers: "*We learned one important lesson, and that is, to truly be valuable to a shipper like a Proctor and Gamble or a Walmart, it's not enough if they deal with this new way of doing things just for their containers that go on the Mærsk line, but they want to do it for all containers. Because if you don't, then you have this problem of [having] one system for one shipper, another for another shipping system*". TradeLens also aims to become a more complete solution in terms of documentation it intends to standardize and digitize. Digital product manager at Mærsk summarized this ambition as: "*So what TradeLens is trying to do is to [...] get rid of everything that is paper-based, or pdf, or fax, or even EDI. [We] want to build next generation data. It is all about [the] exchange of information, and if you are not able to standardize formats and the way you exchange this information, you won't solve the core problem*".

Connecting a large number of actors, digitizing a wide variety of trade documents, and automating multi-party interactions reflects TradeLens' ambition to become a complete industry standard, or "internet of logistics", as referred to by the respondents from Mærsk and GTD Solution. Some of the other interviewees, however, warned that achieving high levels of completeness comes at a cost of increased complexity. This is because numerous exceptions that cannot be automated (e.g. ad-hoc agreements, local requirements) remain a pertinent issue in global supply chains. CEO and Partner at SeaIntelligence Consulting, for example, considered the requirements from customs authorities as a particularly problematic area: "*The moment you start including customs clearance and these types of rules… this is not going to be a global tool. Because customs rules are clearly not aligned, and will never be aligned. TradeLens is global by nature, but these elements will have to be local in nature. [...] There is a high likelihood that in every individual country there is some sort of customs charge. That will be different for all 150 countries*".

High levels of complexity and the existence of numerous exceptions in the global trade environment imply that technology standards in the shipping industry, including those aiming for high levels of completeness like TradeLens, still need to maintain a certain level of generalizability. Relatedly, a number of interviewees see these exceptions as a potential competitive differentiator. Ocean carriers that are able to serve their customers better "when the unexpected occurs" enjoy a competitive advantage over their rivals that otherwise have access to the same standardized common information infrastructure. This notion is encapsulated in a statement by CDIO of MSC: "*We would probably still focus on our own apps. In the end, if you look at our business, I don't believe that technology is going to differentiate the carriers. So I think that some of the things we need to keep, apps we need to keep because that's our way of communicating with the customer, for those who want to do that. [...] Maybe we could use some data from TradeLens to improve our apps [...] There has to be a place where we can still provide a better service than [the competition]. But that service is what keeps you going, not the tech*". In other words, collaborative technology standardization supports innovation even in highly competitive industries, as the common information infrastructure serves as a base upon which ecosystem participants develop their unique innovative solutions.

6.3. Investment vs Value Capture

The final trade-off, investment vs value capture refers to the balance between investing in the standardization efforts, and the distribution of value ultimately created by them. The level of contributions to the development of a standard and the value that could be accrued from it are naturally important considerations for actors engaging in standardization efforts. As noted by the CEO and Partner of SeaIntelligence Consulting: "*If a [shipping] platform is to take off, it should first be useful, and second, there should be a very clear identification – who pays for it, and who gets the money [back] […] If you have a large number of stakeholders involved, you end up with a classical problem. There is probably one company that foots the bill for developing it. The* *system as a whole generates value, but that value is relatively invisible. It is not necessary that someone is getting an income stream out of it. Such a system and digitizing documentation would lead to enormous savings. But it is difficult to convince stakeholders that savings are real. They will say "I'm not seeing any money". This is going to be a problem*".

INTTRA was funded by some of the world's largest ocean carriers, who were considered the main beneficiaries of the value created by the platform. In order to incentivize customer participation in INTTRA, they were not charged for its use. A former member of INTTRA's board of directors, put it this way: "*...we said, "Okay, the carriers are going to benefit from this, so let's get the carriers to fund this". So that helped a little bit because customers were more inclined to use the system because they didn't have to pay for anything. They only paid if they needed integration*". Because of concerns related to the ownership structure of INTTRA, as well as due to the financial crisis of 2008, the platform reached a stalemate. CEO and Partner of SeaIntelligence Consulting described these developments: "*INTTRA never turned a profit – it had to come up with ways to convince carriers to invest more money into it. It couldn't make money by selling shares to non-carriers, because the foundational agreement said that only carriers were allowed to buy shares [...] By 2010 carriers got tired of investing in INTTRA and 51% was sold to a capital fund. Carriers were hands-off, and the fund could develop it any way they want. A lot of money was invested, but they failed to prioritize and started to pursue too many ideas at once, and never got anywhere. And since the fund was unable to sell it after 5 years, the management got fired, and 2 years later they sold it to E2Open".* Initially, the value proposition was unambiguous to the "critical mass" of ocean carriers that were sponsoring INTTRA. Similarly, the level of investment needed to achieve that value proposition was clearly defined within this group of actors, which facilitated INTTRA's initial diffusion. However, problems arose due to the technical nature of the standard developed by INTTRA (i.e. benefitting mostly large industry actors with the resources necessary to maintain EDI connections), as well as the ownership and governance structure that hindered INTTRA's ability to engage with a broader population of industry actors. Collectively, these issues created uncertainty among the "critical mass" of standard supporters about the future value that could be obtained from further investing in the platform, which ultimately hindered its continued development and broader diffusion.

TradeLens, on the other hand, was launched and financed by a single ocean carrier (Mærsk) along with a technology provider (IBM). Interviewees from Mærsk and IBM suggested they started

TradeLens without involving other carriers for pragmatic reasons. The Vice President of Blockchain Solutions at IBM described it this way: "*Mærsk and IBM invested a lot, but sometimes you have to do that to really get the ecosystem going*". Respondents from two companies suggested that a shared information infrastructure would ultimately benefit everyone in the ecosystem because the inefficiencies related to moving documentation permeate the whole industry. However, TradeLens' approach that mostly resembled a commercial project involving a proprietary solution quickly proved ill-suited to the alleged goal of creating a standard infrastructure for the supply chain industry. These issues were described by CEO and Partner at SeaIntelligence Consulting: "*TradeLens basically failed spectacularly in the first 6 to 8 months, because they essentially went out and said: "This is [a] Mærsk and IBM project". And some of the other carriers then asked: "OK if we participate, who owns the IP rights?". To which they replied: "Well we do". No wonder no one wanted to join*". Such concentration of ownership presented a risk for competing ocean carriers, who became concerned that not only would the two companies reap most of the economic benefits, but would also be able to use their power over the platform to compete unfairly by monetizing proprietary data. The sensitivity of handling shared data was highlighted by the President and CEO of Global Container Terminals: "*The monetization of the data has to be done extremely carefully. Mærsk cannot monetize data that they don't own*".

Mærsk and IBM incurred the direct monetary costs for the initial development of the platform, but potential adopters still need to make investments to integrate TradeLens with their legacy systems. Although ocean carriers that adopt TradeLens do not need to pay to be allowed to use the platform, they still invest in the endeavor, albeit in an indirect and intangible manner. These investments come in the form of proprietary data that they contribute to the shared information infrastructure, and implicit expectations to leverage their relationships with big customers and other transaction partners to drive diffusion of TradeLens. Respondents from Pacific International Line (PIL) described this agreement: "*From a carrier's point of view, we do not expect to incur any costs from using any TradeLens modules. Based on TradeLens' business model, TradeLens' services are not chargeable for carriers since they play the key role of bringing in physical cargo volume and onboarding customers to the platform. In return, carriers should be incentivized for onboarding more members to the ecosystem*".

Another important element to consider in regards to this trade-off is the timing of payoffs. Even though the majority of our interviewees were in agreement in that the industry-wide information infrastructure could ultimately create enormous value for the ecosystem, they also indicated that it will take time before these benefits can be realized. As digital product manager at Mærsk opined: "*For Mærsk, I think it was a matter of saying, okay, creating that infrastructure for the industry is something we cannot put a figure on now, let's just put in the money and then see more or less what happens*". A similar sentiment was expressed by the Head of Strategy and Operations at GTD Solution, when asked about the risks for TradeLens: "*The risk is that we're not actually building something that delivers the value that we believe is available. So that would, I guess be the risk that the investment that we're making here is not something that has a realizable return [...] So, we've been very careful in making sure that people know that they're getting into a strategic engagement here*". The CDIO of MSC, also emphasized the role of critical mass in generating value from an industry-wide technology standard: "*TradeLens for me is a long way to follow up to INTTRA. Because digitization in the shipping industry is very, very slow. Believe me, I've been in this for 40 years. So I think we'll start seeing value when we reach critical mass. You can't change processes until you have critical mass, otherwise you're still running two or three parallel processes and that's actually more expensive. So I think we need to reach that critical mass. It will probably take, I would say, probably two or three years".* These quotes imply that rather than seeing a shared information infrastructure as a means to create immediate returns, it should be seen as a foundation upon which the ecosystem actors can build new value adding services and innovative solutions. Further, these findings indicate that the level of interest of relevant actors to support the standardization process are of a dynamic nature and may change over time as the initial solution is refined, initial outcomes appear and the tangible benefits of using the solution are publicized (Monge et al., 1998). Nonetheless, to aid the diffusion of the solution, Mærsk and IBM will likely need to demonstrate the TradeLens' value to ecosystem participants in more tangible terms. The Digital product manager at Mærsk outlined these issues: "*Collaborations [with large partners/rivals] are the toughest ones to nail, because often there have been discussions about what's in it for me? What do I get out of submitting my information and giving away my data?*". Additionally, the two founding companies also need to carefully consider when they can start capturing rents from the platform to justify their investments, since extracting revenue in the early stages might stall TradeLens' diffusion. As noted by the Digital product manager at Mærsk: "*For a platform to succeed you need to generate value before you generate revenue. And often, what we focus on is: "How do we get to the revenue as fast as possible?". But it's kind of contradicting for adoption if you want to look at how fast you can price it. Because the thing is… if it's either cheap or free at the beginning, that would drive* *adoption, but it would not create a lot of revenue. But if you start with a high bill, a lot of people won't be joining at all*".

6.4. Reciprocal relation between trade-offs and changing dynamics

While we have so far presented the analysis of the three trade-offs separately, the data clearly indicate that there is a reciprocal relation between them. INTTRA was created with high levels of inclusion, but low levels of completeness. When certain carriers wanted to include additional features, and make the platform more complete, they ran into problems because other carriers were unwilling to invest in these extensions. Thereby, greater inclusion hindered the ambitions to make the platform more complete. In addition, the reluctance of ocean carriers to further invest in INTTRA also points to the relation with the investment/value capture trade-off, since several ocean carriers considered that higher levels of completeness would not result in sufficient gains to justify the investment that would be necessary to achieve them. Moreover, because Mærsk owned 65% of INTTRA's shares, the carrier would capture a disproportionate level of generated gains, further increasing reluctance of other ocean carriers to fund INTTRA. Thus, high inclusion and uncertainty about who and to what extent would capture the potential benefits from increasing platform completeness prevented INTTRA's continued development and wider diffusion.

With TradeLens, the two core partners opted for higher levels of flexibility, which accelerated the decision-making process in the development phase, but ran into problems with diffusion. In order to accelerate platform adoption, TradeLens started to engage the larger ecosystem by involving industry actors in the decisions regarding platform completeness. This ambition was noted by the Digital product manager at Mærsk: "*First, we built a platform and then from there listened to the outside world, and listened to the requirements, listened to the customers. And then adapted to that along the product development cycle, [...] So if you have a requirement that sounds crazy, if you then validate with 10 other customers and they say the same, maybe it's not that crazy, maybe it's something that you need to include in your portfolio and that's actually the ambition*". A similar sentiment was expressed by the Vice President of Blockchain Solutions at IBM who suggested: "*Today, the actual building of the platform is all done by IBM. So, the entire development is done by my team. Going forward, what happens? We expect some advisory council that grows from the foundation carriers initially, to a much broader community. In some sense, once the community is big enough I'd feel much better because then the community will decide what it needs. That's the place I want to be, as opposed to a small number of players determining* *what goes in there*". Higher levels of inclusion will therefore influence TradeLens' completeness as the platform develops. The decisions on completeness, however, may in turn be contingent on monetary considerations. As noted by the Digital product manager at Mærsk: "*I think right now it's more about driving the adoption and getting the agreement - this is the infrastructure we want to see. Until now, it was more a question of who is going to bear the cost… and funnily enough, no one wants to join that game. So IBM and Mærsk have been paying up until now. And now when you see the adoption is coming, suddenly everybody sees the opportunity of joining…for the future. No one wants to pitch in for the investment that has already gone into it. So how are the two companies going to get that investment back? Of course, that has to be reflected in the ownership structure*".

These findings imply that not only are trade-offs related, but that these interrelations exhibit a dynamic nature. The importance of adaptability was further emphasized by the Digital product manager at Mærsk: "*I think it's very much about getting everybody to realize there's value in that ecosystem and in the standardization. And then what happens afterwards? Don't get fixed on it too early. Because it can go so many ways. If you have a good foundation a lot of stuff is possible. If you start comparing that to other industries, other platforms, there is a lot that will happen over time*".

7. Discussion of Findings

In this section, we draw on our empirical findings to explore the factors influencing technology standardization efforts through collective action. Moreover, we discuss the dynamics involved in the standardization process and how these factors interrelate.

7.1. Collective action Trade-offs

Employing a process-based approach, we scrutinized the phases of standard development and diffusion concurrently and found that organizations involved in collaborative standardization efforts face three distinct, yet highly interrelated trade-offs. In the INTTRA case, the development as well as diffusion of standardized bookings were handled by involving six major ocean carriers in a board-like structure with decision-making powers. This board of directors consisted of representatives of member carriers and served as a dedicated interface (Reuer and Devarakonda, 2016) to guide their interactions, as well as address contingencies and potential conflicts as they arose. Somewhat differently, TradeLens was initiated with a focus on flexibility and speed in development. Findings by Markus et al. (2006) suggest that widespread adoption can prove difficult when user groups that are essential to diffusion of a standard are excluded from its development. In response to concerns similar to those described by Markus et al. (2006), the two founding companies of TradeLens established a separate entity to run the platform (GTD solution), and created an advisory board composed of other members of the supply chain ecosystem. Importantly however, this body does not have explicit decision-making authority. Nevertheless, it represents a part of the "administrative apparatus" (Williamson, 1991) that serves as a conduit for information regarding the technical design choices, and to orchestrate coordinated adaptation between the core partners and the other ecosystem members for further development and diffusion of the standard. The structure of such a collaboration is described here as semi-open due to duality in the approach according to the group of participating actors. While the core alliance of firms that sponsor the standard is limited to a small group of firms with homogeneous and aligned interests and is thus considered "closed", a much larger group of adopting partners is open in the sense that any firm can freely adopt the standard if they so choose (Keil, 2002). Hence, this organizational configuration aimed to address the trade-off between flexibility and inclusion in a structural manner by combining control advantages of a closed alliance consisting of a limited number of partners with a disproportionately high levels of interest and resourcefulness (Marwell and Oliver, 1993), with the market diffusion advantages of mobilizing a broader group of standard adopters.

Such considerations exhibit strong interrelations with other delineated trade-offs. For example, inclusion of a wide variety of different stakeholders has an impact on the completeness of the standard, as numerous actors try to reconcile their internal requirements and advocate for either higher generalizability or higher completeness. Here, collective action serves to adjust the standard to both current and anticipated requirements of actors involved in the standardization effort. In turn, adaptation of the standard attracts new members, further increasing the diversity and size of the adopter population (Foray, 1994). Relatedly, monetization decisions impact how complete the standard can realistically become, as value from a more complete standard accrues to some participants more than others, making the latter less inclined to continuously fund and promote the standard.

Having a standardized solution that is generally accepted by a broad population of actors may come at the expense of the solution's completeness. Although a wide range of different documentation flows through global supply chains, INTTRA was initially only concerned with standardizing shipping instructions. Consequently, using INTTRA did not require major changes in legacy systems of adopting organizations, which simplified adoption and facilitated its initial diffusion. Interestingly, lower levels of completeness were also the reason why INTTRA's subsequent diffusion was hindered. In comparison, adopting TradeLens requires larger adjustments in the participants' often heavily customized legacy systems, which hindered initial diffusion. As a response, TradeLens engaged in strategic openness (Alexy et al., 2017) by including additional stakeholders (via the advisory board), hence moving towards higher inclusion by partly surrendering control over the future direction of the standard. Higher inclusion, in turn, influences the completeness of TradeLens, as the decisions on its future development need to be aligned with other ecosystem participants (notably ocean carriers) for them to continue making contributions to the standardization effort. Additionally, technology standards need to make allowance for technological diversity and functional variety. As a result, a way to address the collective action trade-offs in standardization can involve specifying an "incomplete" standard. One that preserves the advantages of variety by allowing actors to maintain a certain level of specificity in their legacy systems, and introduces mechanisms designed to assist the ex-post inclusion of different interests and disparate specifications within a widely adopted standardized "framework" (Foray, 1994). Thereby, similar to results reported by Jain (2012), our findings suggest that collective action standardization involving committee-like structures and market forces works best when the key actors understand the limits of their influence and accordingly adopt a satisficing approach that involves moving forward with a workable solution acceptable to the relevant parties, rather than striving to achieve an "optimal" outcome where a perfect standard and complete control can be achieved.

Technology standards are only truly valuable when they diffuse widely, meaning that potential standard adopters face significant uncertainties about the costs, benefits, and risks related to standard adoption (Markus et al., 2006). Hence, organizations have little incentive to contribute to the development of a standard without a clear indication of what value they could obtain from it. In the case of INTTRA, several ocean carriers funded the development of the platform because they believed a standard would improve their operational efficiencies enough to justify their initial investment. Owing to these credible commitments (Williamson, 1983) initial diffusion among ocean carriers and large customers was rather straightforward. However, the governance structure of INTTRA prevented the "critical mass" of standard sponsors to translate their level of interest in the standard into actual contributions over time. This resulted in a sluggish process of wider diffusion, further constrained by the failure to improve the completeness of the standard that contributed to INTTRA's inability to generate technical extensions to the standard more in touch with the needs of a wider user base.

With TradeLens, the entire burden of monetary investments rested on the shoulders of Mærsk and IBM. While respondents from Mærsk and IBM indicated that this approach was chosen to more rapidly develop the solution that will benefit the entire ecosystem, it was precisely the exclusive ownership structure that halted the initial diffusion. As in the case of INTTRA, an important part of TradeLens' value proposition were significant operational efficiencies enabled by the standardized common information infrastructure. Further monetization of TradeLens partly depends on charging for the use of applications on its marketplace. This ambition relies on the premise that the development of a timely, salient and adaptable standard is of critical importance for fostering value-creating industry cooperation. It also relies on a joint strategy of maintaining the existing ownership structure, while relinquishing enough control over the future direction of the standard to facilitate willingness among industry actors to participate in identifying ways in which the solution can be modified to accommodate emergent needs.

Table 1 summarizes the trade-offs identified in the analysis.

	Standard development	Standard diffusion
Flexibility vs Inclusion	Small number of actors involved in standard development allows for higher flexibility and speed in decision making, because lower numbers of potentially competing interests need to be aligned ex-ante. Conversely, a large number of actors involved in standard development greatly exacerbates the problem of interest alignment, resulting in slower standard development.	A standard developed by a small group is more difficult to diffuse because interests of the adopter population may not be represented in the proposed standard. In contrast, a standard developed by a large number of actors is easier to diffuse, as the standard already reflects their specific needs.
Generalizability vs Completeness	More generalizable standards are easier to agree upon and develop. However, they could entail that different systems conform to the standard, yet fail to sufficiently interoperate with systems of other organizations that also conform. More complete standards, on the other hand, are more complex and more difficult to develop but ensure a higher level of interoperability.	Generalizable technical standards are better at promoting diffusion because of their relative simplicity and low requirements for modifications to adopters' legacy systems. More complete standards are more difficult to diffuse and generally require higher levels of both monetary and non-monetary investments.
Investment vs Value Capture	Interest alignment and a clear value proposition will make it more likely that actors invest in standard development and vice versa. Additionally, because technology standards are considered an inclusive collective good, any firm in a group is able to consume it, even if it has made disproportionately small contributions to its development. On the other hand, an organization that has a great interest in, and expects significant benefits from a collective good, will gain from making sure the good is provided, even if it has to bear the disproportionately high cost to do so (Marwell and Oliver, 1993; Olsen, 1965).	While a technology standard will readily diffuse among standard sponsors, the diffusion among other organizations depends on both the costs they need to incur to adopt it, as well as on the perceived future value resulting from adoption. However, the value of a technology standard may not be clear in the early stages of the standardization process. Additionally, because standards are only useful when they are widely adopted, organizations may be motivated to delay adoption until they are assured that others will adopt as well.

Table 1: Trade-offs involved in standardization efforts through collective action

Table 2 shows how INTTRA and TradeLens were positioned during the standard development and diffusion phases in terms of the delineated trade-offs.

	INTTRA	
	Standard Development	**Standard Diffusion**
Flexibility vs Inclusion	Started by six major ocean carriers. Because of the need to align interests of involved carriers, the development was slow.	Initial diffusion was successful, backed by contributions by the "critical mass" of standard sponsors. Subsequent diffusion was hindered by the ownership structure.
Generalizability vs Completeness	Standardized shipping instructions being sent between ocean carriers and (large) customers.	Initial diffusion was facilitated by an incomplete/generalizable standard. Subsequent diffusion was impaired by the carriers' inability to reach an agreement regarding higher completeness (adding additional data fields and involving smaller customers).
Investment vs Value Capture	Jointly developed and funded by six major ocean carriers. Customers did not have to pay for using the platform. The main value proposition was a simplified booking process and the associated cost reductions and operational efficiencies.	Because the initial users of the platform were its sponsors and large customers, early diffusion was straightforward. Broader diffusion, however, was impaired by the ambiguous value proposition for smaller customers and other shipping ecosystem members and the ownership/governance structure.

	TradeLens	
	Standard Development	**Standard Diffusion**
Flexibility vs Inclusion	Development was initiated by a single ocean carrier (Mærsk) and a technology provider (IBM). Because of flexibility in decision-making, the development phase was mostly straightforward.	Diffusion proved difficult because other ocean carriers were not involved in the development, and because the two key actors had full claim over TradeLens' IP rights. To help promote diffusion, an advisory board consisting of representatives of other members of the ecosystem was created.
Generalizability vs Completeness	Standardizing a range of documents and involving a broad range of ecosystem members (e.g. Carriers, Ports, Terminals, Customs authorities, Freight Forwarders).	Because TradeLens is a more complete standard (both in terms of the amount of documents it aims to standardize, as well as in terms of actors it aims to connect) it is also more complex and difficult to diffuse. Adopting TradeLens requires investments in integration, change management and user training.
Investment vs Value Capture	Funded by Mærsk and IBM. Other carriers do not have to pay for using the platform, but invest indirectly by contributing their data and/or leveraging business relationships to aid diffusion. The main source of revenue comes from charging customers (shippers) for using the platform. Additionally, TradeLens promises to decrease costs and improve operational efficiencies for participants through enhanced information exchange.	Initial diffusion was difficult, because the concentrated ownership created a threat that the platform would disproportionately benefit Mærsk alone. To aid diffusion, a third-party entity (GTD solution) was established, and the TradeLens advisory board was introduced. Although other ocean carriers need to incur the cost of integration, they are not charged for using the platform. They are, on the other hand, implicitly expected to help onboard additional participants.

Table 2: Trade-offs involved in standardization efforts through collective action

Figure 1 shows the interactions between trade-offs as they move back and forth between processes of standard development and diffusion.

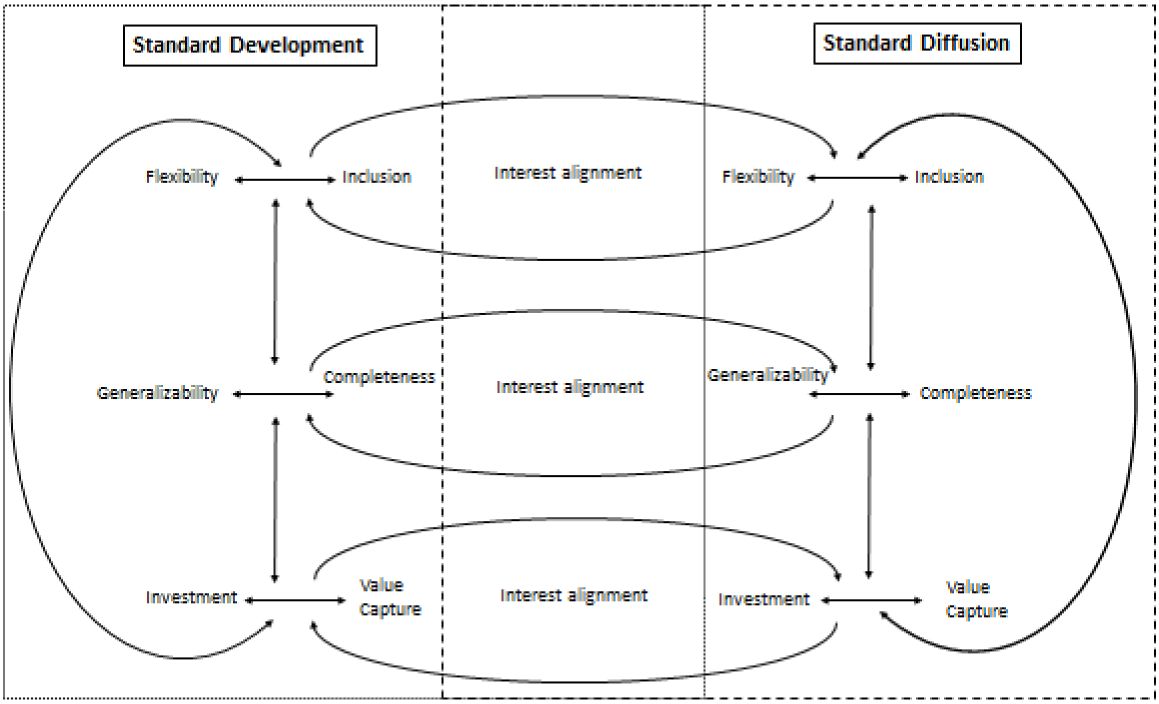

Figure 1: Interactions between trade-offs as they move between development and diffusion

Consistent with assumptions of collective action theory (Marwell and Oliver, 1993), our analysis reveals that what matters crucially to the provision of a standard is the pattern of interrelations among the contributors in the "critical mass", not the relations among everyone in the wider group of parties that would benefit from successful standardization. For example, while the "critical mass" of organizations involved in both INTTRA and TradeLens consisted of a small number of actors with a high level of interest and the ability to make contributions of money, time, and other resources toward the standardization effort, the governance structure of INTTRA prevented actors in the "critical mass" from exerting influence proportional to their level of interest in standard provision. On the other hand, the two core partners in TradeLens, while partially relinquishing control of the direction in which a standard develops to other industry parties to aid diffusion, nevertheless maintained decision-making authority, which kept the levels of both key collective action factors high. Even though the solution INTTRA had developed diffused relatively quickly among the large ocean carriers, the momentum of the drive towards industry standardization was eroded because the governance issues progressively reduced the willingness of key actors to contribute resources toward supporting the standardization process, although their level of interest in its provision remained high. This finding points to the importance of maintaining high levels of both the interest in standard provision and the willingness to commit resources to support the continuing process of standardization among the "critical mass" of standard sponsors. Further, it suggests that moving beyond the development phase and successfully diffusing the solution requires a flexible approach. One that would allow for adaptive equilibrium seeking by maintaining consistency in the governance architecture within the "critical mass" of actors such that the levels of both key collective factors remain high, while at the same time engaging in strategic openness (Alexy et al., 2017) to incentivize adoption.

8. Implications

Although studies in technology standardization have recognized the importance of simultaneously analyzing the phases of standard development and diffusion (Markus et al., 2006), and employed a new process-based perspective (Botzem and Dobush, 2012; Wiegmann et al., 2017), which has documented the dynamic nature of standardization (Jain, 2012; Wiegmann et al., 2017), the literature provides few insights about the specific interactions involved in these processes (Wiegmann et al., 2017). Consequently, our understanding of the process of standardization where involved actors may, at different points in time, play different roles, have varying levels of interest in standard provision, and employ different strategies to drive standardization remains limited. Our study contributes to the emerging literature on technology standardization through collective action by providing insights into the reciprocal relationship between particular governance configurations and participating actors' level of interest and willingness to contribute resources to the standardization effort. Further, we provide evidence that these relationships exhibit variability through both stages of standard development and diffusion, which in turn gives the standardization process its dynamic nature. We capture these insights in the three delineated collective action trade-offs (i.e. flexibility vs inclusion, generalizability vs completeness, and investment vs value capture). The trade-offs encapsulate not only strategic responses to economic and technical exigencies of organizations with commercial interests at stake, but also explain how the process of standardization evolves through the interplay between factors that simultaneously drive the phases of standard development and diffusion, and are in turn shaped by them. In other words, we offer insights into how market forces can be harnessed to collectively address an industry need, in the absence of a body with decision-making and coercive authority.

Further, our findings offer tentative insights relevant for an emerging perspective in standardization research that goes beyond the archetypes of committee, market and government-driven standardization, and instead argues that a multi-mode approach will become increasingly prevalent due to the complexity of modern technological systems and the wide variety of actors involved in standardization efforts (Wiegmann et al., 2017). For example, both INTTRA and TradeLens engaged in standardization through committee-like structures to foster cooperation (Wiegmann et al., 2017), while at the same time relying, albeit in different ways, on the wider market to both refine and promulgate the standards.

These arguments further point to the implications of our findings for managerial decision-making in practice. Technological innovations and competitive forces have steadily reduced costs of transacting beyond the boundaries of the firm, which has increased the value of inter-organizational collaboration by enabling firms with unique capabilities to combine their resources and drive innovation and value creation. This has further led to the development of large and complex systems (Constantinides and Barrett, 2015; Saadatmand et al., 2019), which critically rely on standards (Wiegmann et al., 2017). A key insight of our study is that managing such complex projects involves crucial trade-offs, where managerial, technical design and governance decisions have both feed-forward and feed-back effects. Additionally, we highlight the importance of strategically engaging, and re-engaging with different groups of industry actors that have a stake in the outcome of the standardization process. We describe how organizations need to strike a balance between maintaining the ability to exert decision-making influence proportional to their interest in standard provision, and remaining attentive to market needs by introducing governance mechanisms that more directly engage with other industry participants, collaborators and competitors alike.

9. Limitations

This study is a subject to several limitations. Firstly, our study is limited to examining collective action of actors in two standardization efforts based on specific technological solutions within the shipping industry. It therefore remains an open question whether our findings can generalize more widely to IT product standardization besides inter-organizational information exchange systems (Rosenkopf et al., 2001; Uotila et al., 2017), or other types of organizational collective action such as the development of open-source solutions (Witzel et al., 2006). However, we do achieve generalization from empirical description to theory (Saadatmand et al., 2019) by employing a process approach that entailed an extensive analysis of existing standardization literature, both general and more specific to technology standardization, which has informed our analysis of the empirical material and vice versa. Accordingly, our results show significant promise especially for researchers seeking to understand complex industry-wide standardization, as well as for practitioners in charge of managing collaborative efforts where technical and organizational solutions aimed at supporting mutually beneficial collective action need to be designed and dynamically adapted in a contested and competitive environment.

Secondly, we have collected data on two cases that exhibit some notable differences. While the primary data relating to INTTRA originates from key decision-makers with extensive knowledge of the relevant events that took place, and the processes that unfolded, they nevertheless represent respondents' retrospective accounts. Additionally, although our empirical approach entailed leveraging key decision-makers' knowledge to gather insights concerning TradeLens over a three year period of its existence, TradeLens is still an ongoing project and can thus be considered a "standard in the making". Taken together, the data's diversity and sheer volume can raise concerns about the completeness and accuracy of the record (Saadatmand et al., 2019), especially in the case of INTTRA where retrospective accounts from interviews were relied upon to a high degree. To address these concerns, we have applied several techniques including repeated interviews with key actors to corroborate claims by other respondents, and applying different lenses to our analysis (e.g. considering interactions between trade-offs within and across the phases of standard development and diffusion both from a theoretical and an empirical perspective).

We further recognize that it is likely that the collective action trade-offs we outline in this paper do not cover the full extent of factors that influence technology standardization processes. One of these factors could, for example, be a role of the national governments. Because of the global nature of the shipping industry, there will likely be political tensions that influence technology standardization efforts, particularly because a common information infrastructure could imply sharing commercially and politically sensitive data. Finally, governmental authorities and standard-setting bodies, such as ISO or DCSA will potentially have an influence on the continuing development of the standardization processes we analyze in this paper. A way to "sidestep conflict" in a continuing standardization process involving industry rivals could involve borrowing and adapting specifications developed elsewhere, rather than creating extensions and new solutions from scratch (Jain, 2012).

Despite their limitations, observations from this study could provide important insights to organizations embarking on a technology standardization journey. Furthermore, we do not see the possibility that our findings do not generalize beyond technology standardization processes in the shipping industry as an acute flaw of our study. Global supply chains that critically rely on container shipping play an important role in economic growth, and overall human development and welfare worldwide, especially in the wake of the Covid-19 pandemic. The shipping industry accounts for the delivery of almost 90% of all goods (Klose, 2005), which were valued at close to $18 trillion in 2017[34]. Explicating standardization processes in the context of container shipping is therefore of great practical relevance.

Furthermore, future standardization studies could apply the three delineated trade-offs as analytical tools with which to explore technology standardization through collective action in other industries involving numerous actors with heterogeneous interests. Researchers could also continue following the TradeLens case as it develops further, and evaluate the impacts of each of the proposed trade-offs on the platform diffusion and continued development, as well as shifting dynamics within each trade-off and their respective effects. Finally, future research could explore how factors such as power, reputation and credibility of involved actors influence the trade-offs delineated in our analysis, and their implications for the standardization process.

10. Conclusions

Standards play a crucial role in supporting technological developments that enable ever more complex and innovative forms of collaboration across organizational boundaries. This study provides an in-depth exploration of the dynamics and factors that unfold and interrelate within a process of technology standardization. In doing so, we indicate how actors can overcome the challenges of collective action and delineate three novel collective action trade-offs. We further propose these trade-offs as analytical tools for investigating how technology standardization through collective action on an industry level arises and evolves. Our study extends the literature on technology standardization in several ways. Firstly, we take a process perspective to gain a

[34] "World Trade Statistical Review 2018", World Trade Organization, available at: https://www.wto.org/english/res_e/statis_e/wts2018_e/wts2018_e.pdf

more nuanced understanding of how the interests of actors involved in standardization efforts evolve and interact over time. In other words, rather than approaching technology standard development and diffusion as problems of resource allocation based on heterogeneous interests (Monge et al., 1998; Markus et al., 2006), we seek to explicate the dynamics of the technology standardization process as they unfold. We suggest that it is the interactions among the "critical mass" of standard supporters, and the organizational and governance choices that either constrain or enable the engagement with a wider population of standard adopters that ultimately determine the direction in which a standardization process develops.

Secondly, we consider not only the heterogeneity of interests among involved actors (Markus et al., 2006), but also the extent of interest in the standard as a collective good, further refining our understanding of how technology standards emerge and evolve. We show that it is not essential that every party interested in standard provision participates in governance or decision-making. Based on theoretical predictions of collective action theory (Olson, 1965), this insight suggests that an industry standard is an inclusive collective good where the benefits accrued by non-cooperators are not matched by corresponding losses to the cooperators. This insight contributes to the existing technology standardization literature by providing evidence that questions the importance of the "free-rider" problem that is often discussed by standardization scholars (e.g. Kindlberger, 1983; Weiss and Cargill, 1992; Markus et al., 2006). More broadly, our study highlights the need for an improved understanding of technology standardization as a dynamic process, which is proving to be increasingly important in the contemporary business environment. We hope that future research can benefit from our insights and tests them in other empirical settings.

References

Alexy, O., West, J., Klapper, H., & Reitzig, M. (2018). Surrendering control to gain advantage: Reconciling openness and the resource-based view of the firm. *Strategic Management Journal, 39*(6), 1704-1727.

Allison, I., (2018). IBM and Maersk Struggle to Sign Partners to Shipping Blockchain. *Available at:* https://www.coindesk.com/ibm-blockchain-maersk-shipping-struggling

Anderson, J.E., & van Wincoop, E., (2004). Trade Costs. Journal of Economic Literature 42, No. 3, 691-751

Axelrod, R., Mitchell, W., Thomas, R. E., Bennett, D. S., & Bruderer, E. (1995). Coalition formation in standard-setting alliances. *Management science*, 41(9), 1493-1508.

Bala, H., & Venkatesh, V. (2007). Assimilation of interorganizational business process standards. *Information systems research*, *18*(3), 340-362.

Barua, A., & Lee, B., (1997). An economic analysis of the introduction of an electronic data interchange system. *Information Systems Research 8* (4): 398-422.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2), 77-101.

Browning, L. D., Beyer, J. M., & Shetler, J. C. (1995). Building cooperation in a competitive industry: SEMATECH and the semiconductor industry. *Academy of Management Journal*, *38*(1), 113-151.

Cargill, C.F., (1989). *Information Technology Standardization: Theory, Process, and Organizations.* Digital Press, Bedford, MA.

Cargill, C.F., (1997). *Open systems standardization: A business approach*. Prentice Hall.

Cargill, C.F., (2002). Uncommon Commonality: A Quest for Unity in Standardization. In Sherrie Bolin, ed., *The Standards Edge*, Ann Arbor, MI: Bolin Communications, 2002, 29–39.

Christ, M.H. & Nicolaou, A.I. (2016). Integrated information systems, alliance formation, and the risk of information exchange between partners. *Journal of Management Accounting Research 28* (3): 1-18.

Chiao, B., Lerner, J., & Tirole, J. (2007). The rules of standard-setting organizations: An empirical analysis. The *RAND Journal of Economics, 38*(4), 905-930.

Collis, J., & Hussey, R. (2013). *Business Research: Practical Guide for Undergraduate and Postgraduate Students* (4th ed.). Basingstoke: Palgrave Macmillan.

Constantinides, P., & Barrett, M. (2015). Information Infrastructure Development and Governance as Collective Action. *Information Systems Research 26*, 1, 40-56.

Dattée, B., Alexy, O., & Autio, E. (2018). Maneuvering in Poor Visibility: How Firms Play the Ecosystem Game when Uncertainty is High. *Academy of Management Journal 61*, 2, 466-498.

David, P.A., (1985). Clio and the economics of QWERTY. *American Economic Review 75*, 2, 332–337.

David, P.A. (1995). Standardization Policies for Network Technologies: The Flux Between Freedom and Order Revisited in Standards, Innovation and Competitiveness: *The Politics and Economics of Standards in Natural and Technical Environments*, R. Hawkins, R. Mansell, J Skea (eds.), Science Policy Research Unit, University of Sussex.

David, P.A., & Greenstein, S. (1990). The Economics Of Compatibility Standards: An Introduction To Recent Research. *Economics of Innovation and New Technology 1* (1-2): 3-41.

Farrell, J., & Saloner, G. (1985). Standardization, compatibility, and innovation. *RAND Journal of Economics 16*, 70-83.

Farrell, J., & Saloner, G. (1988). Coordination Through Committees and Markets. *The RAND Journal of Economics* 19, 2, 235-252.

Farrell, J. & Shapiro, C. (1992). Standard Setting in High-Definition Television. *Brookings Papers on Economic Activity: Microeconomics* 1–77.

Foray, D. (1994). Users, Standards and the Economics of Coalitions and Committee. *Information Economics and Policy 6*, 269-293.

Gioia, D.A., Corley, K.G., & Hamilton, A.L. (2013). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods 16*(1), 15-31.

Glaser, B.G., & Strauss, A.L. (2017). *Discovery of grounded theory: Strategies for qualitative research*. Routledge.

Greenstein, S., (1992). Invisible Hands and Visible Advisors: An Economic Interpretation of Standardization. *Journal of the American Society for Information Science* (43:8), 538-549.

Hardin, R., (1982). Collective Action. RFF Press.

Jensen, T., Hedman, J., & Henningsson, S. (2019). How TradeLens Delivers Business Value With Blockchain Technology. *MIS Quarterly Executive 18*, 4.

Jain, S., (2012). Pragmatic agency in technology standards setting: The case of Ethernet. *Research Policy 41*, 9, 1643-1654.

Jovanović, M., Sjödin, D., & Parida, V. (2021). Co-evolution of platform architecture, platform services, and platform governance: Expanding the platform value of industrial digital platforms. *Technovation*, 102218.

Katz, M.L., & Shapiro. C., (1985). Network externalities, competition, and compatibility. *American Economic Review 75*, 424-440.

Keil, T., (2002). De-facto standardization through alliances: Lessons from Bluetooth. *Telecommunications Policy*, *26*, 205–213.

Klein, R., Rai, A., & Straub D.W. (2007). Competitive and Cooperative Positioning in Supply Chain Logistics Relationships. *Decision Sciences 38*, 4, 611-646.

Klose, A., (2015). *The Container Principle: How a Box Changes the Way We Think*. MIT Press.

Kindleberger, C. P. (1982). *Standards as public, collective and private goods*. IIES.

Kollock, P., (1998). Social Dilemmas: The Anatomy of Cooperation. *Annual Review of Sociology 24*, 183-214.

Kostić, N., Sedej, T., 2020. Blockchain technology, inter-organizational relationships and management accounting: A synthesis and research agenda. (May 16, 2020). Working paper, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3603672

Leiponen, A.E. (2008). Competing Through Cooperation: The Organization of Standard Setting in Wireless Telecommunication. *Management Science 54*, 11, 1904-1919.

Markus, M.L., Steinfield, C.W., Wigand, R.T., & Minton, G. (2006). Industry-Wide Information Systems Standardization as Collective Action: The Case of the U.S. Residential Mortgage Industry. *MIS Quarterly 30*: 439-465.

Marwell, G., & Oliver, P. (1993). *The Critical Mass in Collective Action: A Micro-Social Theory*. Cambridge University Press.

Miles, M.B., & Huberman, A.M. (1994). *Qualitative Data Analysis* (2nd ed.). London: Sage.

Miller, D.C., & Salkind, N.J. (2002). *Handbook of research design and social measurement*. Sage.

Monge, P.R., Fulk, J., Kalman, M.E., Flanagin, A.J., Parnassa, C., & Rumsey, S. (1998). Production of Collective Action in Alliance-Based Interorganizational Communication and Information Systems. *Organization Science 9*, 3, 255-433.

Narayanan, V.K., & Chen, T. (2012). Research on technology standards: Accomplishment and challenges. *Research Policy 41*, 8, 1375-1406.

Olson, M., (1965). *The Logic of Collective Action: Public goods and the Theory of Groups*. Harvard University Press, Boston, 1965.

Outila, J., Keil, T., & Maula, M. (2017). Supply-Side Network Effects and the Development of Information Technology Standards. *MIS Quarterly* 41, 4.

Reuer, J., & Devarakonda. S.V. (2016). Mechanisms of Hybrid Governance: Administrative Committees in Non-Equity Alliances. *Academy of Management Journal 59*, 2, 510-533.

Rosenkopf, L., Metiu, A., & Varghese P.G. (2001). From the Bottom Up? Technical Committee Activity and Alliance Formation. *Administrative Science Quarterly 46*, 4, 748-772.

Saadatmand, F., Lindgren, R., & Schultze. U. (2019). Configurations of platform organizations: Implications for complementor engagement. *Research Policy 48*, 8.

Schloetzer, J.D. (2012). Process Integration and Information Sharing in Supply Chains. *The Accounting Review 87*, 3, 1005-1032.

Simcoe, T. (2012). Standard Setting Committees: Consensus Governance for Shared Technology Platforms. *American Economic Review 102*, 1, 305-36.

Steinfield, C., Markus, M.L., & Wigand. R.T., (2011). Through a glass clearly: Standards, architecture, and process transparency in global supply chains. *Journal of Management Information Systems 28*, 2, 75-108.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research*. Sage publications.

Tassey, G. (2000). Standardization in technology-based markets. *Research Policy 29*, 587-602.

Thomas, L. D. W., & Ritala, P. (2021). Ecosystem Legitimacy Emergence: A Collective Action View. *Journal of Management*. January, 2021

Van den Ende, J., van de Kaa, G., den Uijl, S., & de Vries. H.J. (2012). The Paradox of Standard Flexibility: The Effects of Co-evolution between Standard and Interorganizational Network. *Organization Studies 33*, 5-6, 705-736.

Voorspuij, J., & Becha, H., (2021). Digitalisation in Maritime Regional and Global Supply Chains. In: *Maritime Informatics*. Eds: Lind, M., Michaelides, M., Ward, R., & Watson, R.Th. Springer. https://doi.org/10.1007/978-3-030-50892-0

Wade, J. (1995). Dynamics of organizational communities and technological bandwagons: an empirical investigation of community evolution in the microprocessor market. *Strategic Management Journal 16* (Special Issue), 111–133.

Weiss, M., & Cargill, C. (1992). Consortia in the standards development process. *Journal of the American Society for Information Science 43*, 8, 559-565.

Weitzel, T., Beimborn, D., & Koenig, W. (2006). A Unified Economic Model of Standard Diffusion: The Impact of Standardization Cost, Network Effects, and Network Topology. *MIS Quarterly*, (30: Special Issue on Standard Making), 489-514.

West, J. (2007). The economic realities of open standards: Black, white and many shades of gray. *Standards and public policy, 87*, 122.

Wiegmann, P.M., de Vries, H.J., & Blind, K. (2017). Multi-mode standardization: A critical review and a research agenda. *Research Policy 46*, 8, 1370-1386.

Williamson, O.E., (1991). Comparative Economic Organization: The Analysis of Discrete Structural Alternatives. *Administrative Science Quarterly 36*, 2, 269-296.

Williamson, O.E., (1983). Credible Commitments: Using Hostages to Support Exchange. *The American Economic Review 73*, 4, 519-540.

Yin, R.K., (2009). *Case study research: Design and methods* (5th ed.). Thousand Oaks, CA: SAGE

Zhao K., Xia, M., & Shaw, M.J. (2011). What Motivates Firms to Contribute to Consortium-Based E-Business Standardization? *Journal of Management Information Systems 28*, 2, 305-334.

Zhao, K., & Xia, M. (2014). Forming Interoperability Through Interorganizational Systems Standards. *Journal of Management Information Systems 30*, 4, 269-298.

Zhu, K., Kraemer, K.L., Gurbaxani, V., & Xu, S.X. (2006). Migration to Open-Standard Interorganizational Systems: Network Effects, Switching Costs, and Path Dependency. *MIS Quarterly 30*: 515-539.

Appendix A: Overview of conducted interviews

Column labelled "Case" indicates which of the two analyzed cases was the focal point of a particular interview. Whenever possible, we have selected interviewees that were involved in both projects.

Date	Type	Position	Company	Case	Location
2.5.2018	Interview	Digital product manager	Mærsk	TradeLens	Case site (Mærsk)
24.5.2018	Interview	Lead IT architect	GTD/TradeLens	TradeLens	Case site (GTD/TradeLens)
14.6.2018	Interview	Special consultant/Chief consultant	Ministry of Industry, Business and Financial Affairs	TradeLens	Ministry of Industry, Business and Financial Affairs
3.7.2018	Interview	Digital product manager	Mærsk	TradeLens/INTTRA	Case site (Mærsk)
14.3.2019	Interview	Digital product manager	Mærsk	TradeLens/INTTRA	Case site (Mærsk)
4.7.2019	Interview	Global Head of Integration	APM Terminals	TradeLens/INTTRA	Case site (Mærsk)
10.10.2019	Interview	CEO, Partner (SeaIntelligence Consulting), Former Mærsk representative (INTTRA)	SeaIntelligence Consulting/INTTRA	INTTRA/TradeLens	SeaIntelligence Consulting
21.10.2019	Interview	Digital product manager	Mærsk	TradeLens	Case site (Mærsk)
30.3.2020	Interview	Digital product manager	Mærsk	TradeLens/INTTRA	Online/Zoom
31.3.2020	Interview	Head of Strategy and Operations	GTD/TradeLens	TradeLens	Online/Zoom
20.5.2020	Interview	CDIO (MSC); Chairman (DCSA)/ Former member of board of directors (INTTRA)	MSC/DCSA/INTTRA	TradeLens/INTTRA	Online/Zoom
26.5.2020	Interview	Project (Stream) Lead at Global International team	Anheuser-Busch InBev	TradeLens/INTTRA	Online/Zoom
26.5.2020	Interview	Vice President, Blockchain Solutions	IBM	TradeLens	Online/Zoom
3.6.2020	Interview	Sloan Distinguished Professor of Management	MIT Sloan	Technology standardization general	Online/Zoom
10.6.2020	Interview	President/CEO	Global Container Terminals Inc.	TradeLens	Online/Zoom
7.7.2020	Interview	Various departments	Pacific International Lines	TradeLens	E-mail
3.9.2020	Interview	CTO	Youredi	TradeLens	Online/Zoom
9.9.2020	Interview	CIO	YILPORT holding	TradeLens	Online/Zoom

Appendix B: Overview of conferences and webinars

Date	Type	Title	Organizer	Location
4.11.2017	Conference participation	Nordic Blockchain conference	ITU Copenhagen	ITU Copenhagen
18.4.2018	Conference participation	Blockchain conference and exhibition	Blockchain Expo World Series	Olympia London
18.6.2019 - 20.6.2019	Conference participation	TOC Europe	TOC Events Worldwide	Ahoy, Rotterdam
11.11.2019	Conference participation	SHIP TECH: Conference on the future of shipping	ShippingWatch/Relevent	Copenhagen
19.2.2020	Webinar	Learning about DCSA's Track & Trace standards	DCSA	Online
12.5.2020	Webinar	Digitalisation and data standardisation: time for the maritime industry to act	Maritime Optimization and Communications	Online
26.5.2020	Webinar	Adjusting to the 'New' New Normal: The Impact of COVID-19	TOC Events Worldwide	Online
9.6.2020	Webinar	Accelerating Digitalization: The role of start-up tech in post-COVID-19 supply chains	TOC Events Worldwide	Online
9.6.2020	Webinar	Advancing Global Trade with Blockchain	IBM Blockchain	Online
3.7.2020	Webinar	Where next for global shipping?	CBS Executive MBA in Shipping and Logistics	Online
14.7.2020	Webinar	Global Overview of the Container Shipping Market	Intermodal Digital Insights	Online
15.7.2020	Webinar	Global Smart Container Forum	Intermodal Digital Insights	Online
5.8.2020	Webinar	An electronic bill of lading, considered the holy grail of the maritime industry	IBM Blockchain/TradeLens	Online
12.8.2020	Webinar	How 3PLs and FFWs move from linear logistics to a platform business model	IBM Blockchain/TradeLens	Online
19.8.2020	Webinar	BiTA + TradeLens: Alignment & Opportunities Moving Forward	FreightWaves	Online
16.12.2020	Webinar	Youredi Now Offering Expert Services for Shippers Connecting to TradeLens	IBM Blockchain	Online
17.2.2021	Webinar	The future for ship-shore community data sharing - a public highway or individual toll roads?	International Association of Ports and Harbors	Online
24.2.2021	Webinar	The 4th Industrial Revolution in Ports. How the Terminal Industry is Setting the Standards	TOC Digital	Online
25.2.2021-3.3.2021	Virtual conference participation	TPM21: The premier conference for the trans-Pacific and global container shipping and logistics community	Journal of Commerce and IHS Markit	Online

Appendix C: Overview of the secondary data sources

Outlet	Webpage
INTTRA Webpage	https://www.inttra.com/
E2Open	https://www.e2open.com/
TradeLens webpage	https://www.tradelens.com/
TradeLens blog	https://www.tradelens.com/blog
TradeLens press releases	https://www.tradelens.com/blog/all-press-releases
TradeLens documentation	https://docs.tradelens.com/
GTD Solution webpage	https://www.gtdsolution.com/
Digital Container Shipping Association (DCSA)	https://dcsa.org/
JOC.com (Container shipping and trade news and analysis)	https://www.joc.com/
Coindesk	https://www.coindesk.com/
Ledger Insights	https://www.ledgerinsights.com/
LinkedIn posts	https://www.linkedin.com/
Twitter Posts	https://twitter.com/
IBM Blockchain	https://www.ibm.com/blockchain
Coin Telegraph	https://cointelegraph.com/
The Loadstar	https://theloadstar.com/
Container news	https://container-news.com/
SeaIntelligence consulting	https://www.seaintelligence-consulting.com/
Supplychain dive	https://www.supplychaindive.com/
Global Trade review	https://www.gtreview.com/
Globe newswire	https://www.globenewswire.com/en
Logistics Middle East	https://www.logisticsmiddleeast.com/
Seatrade Maritime News	https://www.seatrade-maritime.com/
Port Technology	https://www.porttechnology.org/
Express Computer	https://www.expresscomputer.in/
Container Management	https://container-mag.com/
The Maritime Executive	https://www.maritime-executive.com/
BTC Manager	https://btcmanager.com/
PR Newswire	https://www.prnewswire.com/
Splash247.com	https://splash247.com/
Business Blockchain HQ	https://businessblockchainhq.com/
Market Research Reports	https://www.marketresearchreports.com/maritime
Harvard Business Review	https://hbr.org/
MIT Technology Review	https://www.technologyreview.com/
The National Law Review	https://www.natlawreview.com/

Chapter 4: Paper 3: Development of inter-firm collaboration on a blockchain-based platform: Lessons from TradeLens

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Abstract

Proliferation of enterprise blockchains in recent years has prompted scholars across various disciplines to explore conditions leading to their successful deployment. Research has shown that establishing collaboration between industry participants is an essential precondition for successful implementation of industry-wide enterprise blockchains. At the same time, it is also one of the biggest challenges inherent to blockchain initiatives, as companies are hesitant to contribute to a common information infrastructure, which often needs to be shared with rivals. Additionally, considerations about ownership of the blockchain system, the distribution of value created by it and a potential for misuse of proprietary data shared on a blockchain network continue to be a concern. This paper follows the development of TradeLens, a shipping platform underpinned by the blockchain technology, and examines the process of building collaboration between actors in global supply chains. Based on data collected from key participants in the TradeLens ecosystem, it identifies three elements, namely value creation, governance and interoperability that are of crucial importance to successful diffusion of enterprise blockchain networks such as TradeLens.

Keywords: Blockchain; inter-organizational relationships; collaboration; information systems; transaction costs

1. Introduction

"*I won't mince words here – we do need to get the other carriers on the platform. Without that network, we don't have a product. That is the reality of the situation*." Marvin Erdly, Head of TradeLens at IBM Blockchain, (Allison, 2018).

Recently both executives and academics started to recognize the business potential of enterprise blockchains (e.g. Lacity et al., 2019; Schmidt and Wagner, 2019; Kostić and Sedej, 2020; Lumineau et al., 2020). Companies across the globe started to form consortia to explore the benefits of this nascent technology (Ziolkowski et al., 2020), and the amount of research on the topic is picking up swiftly (Nærland et al., 2017). International Data Corporation (IDC) forecasts that the worldwide spending on blockchain solutions will reach nearly $15.9 billion by 2023 (IDC, 2019).

Since blockchains are uniquely fitted to sharing, verifying and securing transactional data, they are particularly useful for managing multi-party, inter-firm, and cross-border transactions (Van Hoek and Lacity, 2020). As such, they can be used to manage various forms of inter-organizational relationships (IORs) (Kostić and Sedej, 2020; Lumineau et al., 2020). Successful enterprise blockchain implementations, however, necessitate collaboration between multiple parties within an industry (Rauchs et al., 2019). Because blockchains are, by design, multi-party systems (Glaser, 2017), they can only reach their full potential if all parties relevant to a trade utilize the same network (Rauchs et al., 2019). The central issue of successful enterprise blockchain implementation may therefore be how to induce collaboration between trading partners and, very likely, competitors (Lacity et al., 2019).

This paper follows the development of TradeLens, a supply chain platform, underpinned by blockchain technology[35], jointly developed by Mærsk, a logistics conglomerate, and IBM, a multinational information technology company. TradeLens was designed with the aim of decreasing transaction costs, allowing secure information exchange and providing end-to-end visibility and traceability in global supply chains. Appendix A provides an overview of the TradeLens solution. Because global supply chains are extremely complex and often highly

[35] TradeLens uses the IBM Blockchain Platform, which is based on Hyperledger Fabric. See: https://www.ibm.com/blockchain

inefficient, successful deployment of TradeLens, or a similar industry-wide platform, could provide significant economic benefits for all actors within the ecosystem.

Successful deployment of an industry-wide blockchain-based platform such as TradeLens, however, is contingent on building collaboration between multiple parties. Although achieving collaboration between industry actors has been observed as an indispensable prerequisite to successful enterprise blockchain implementations (e.g. Mattke et al., 2019; Zavolokina et al., 2019), it is not an easy task. Not only is a certain level of collaboration required between competitors, joining a blockchain network also involves investments in relationship-specific assets (e.g. integration with a firm's legacy systems), which may be lost, if the platform ultimately fails to realize its potential. Additionally, firms are reluctant to share their data through a common platform and risk being exposed to potential opportunistic behavior by other parties in the network.

Establishing collaboration across the ecosystem also presented a challenge for Mærsk and IBM in late 2018, as the companies were struggling to attract other ocean carriers to join their blockchain solution (Allison, 2018). The core issue was the rights to intellectual property. TradeLens was initially envisioned as a Joint Venture between Mærsk and IBM with a 51/49 split (Jensen et al., 2019). Such concentration of power among platform owners poses the threat of disadvantaging other platform participants, as the owners may prioritize their own interests over those of other stakeholders (Chen et al., 2020). As a result, several of Mærsk's competitors were concerned about joining the platform on a less than an equal footing, which they initially refused. The fact that TradeLens is co-owned by Mærsk created the risk that the carrier could gain access to competitors' data, its power over the platform to compete unfairly, as well as extract most of economic benefits from the network. Because of these concerns, as well as complicated regulatory approval processes related to the establishment of a new company, the idea of a joint venture was abandoned in fall of 2018. The ownership structure of TradeLens moved from joint venture to a subsidiary of Mærsk, called GTD Solution[36] (Jensen et al., 2019). By mid 2020, TradeLens gained participation[37] of more than 170 ecosystem members, including five out of six of the world's largest shipping companies collectively accounting for 66% of global container volume

[36] For more information see: https://www.gtdsolution.com/
[37] At the time of data collection, the majority of interviewed participants have signed a memorandum of understanding (MOU), and were only sharing test data. In October 2020, CMA CGM and MSC announced they joined TradeLens as Foundation carriers, and started sharing production data (TradeLens, 2020a)

(TradeLens, 2020b). Nonetheless, TradeLens' ambition is to further grow the network and eventually reach a critical mass (Johnson, 2020), necessary for its success.

While previous studies (e.g. Nærland et al., 2018; Jensen et al., 2019) already explored TradeLens in various details, this paper focuses particularly on the process of building collaboration[38] across ecosystem participants and driving adoption of the platform. More specifically, it aims to identify the most critical elements influencing the decision of shipping ecosystem actors to join TradeLens.

In order to accomplish that, data were collected through interviews at Mærsk, IBM, GTD Solution and several other ecosystem actors, as well as participating in industry events, during 2018-2020. Analysis of rich qualitative data reveals three key elements, namely value creation, governance and interoperability that were crucial in influencing the decision of industry actors to join TradeLens. The value creation dimension pertains to the benefits TradeLens promises to deliver to potential adopters. Importantly, it focuses on the value propositions that differentiate TradeLens from competing blockchain-based shipping platforms. The governance dimension is related to safeguards, which TradeLens employs to assure potential joiners that decisions on functioning and development of the platform will not unilaterally be made by Mærsk and IBM, benefiting the two companies at the expense of others. On an operational level, TradeLens also uses safeguards to ensure that participants' proprietary data will not be exposed to potential opportunism by other actors on the blockchain network. The interoperability dimension is related to inefficiencies and risks for potential participants, which could arise if TradeLens does not ensure seamless interconnectivity between the platform and legacy systems, as well as between the platform and competing blockchain-based shipping platforms. Additionally, this study highlights the importance of decisions taken during the design of a blockchain system, and explains how they influence system's characteristics, such as security, transparency and scalability. Finally, it outlines specific risks facing firms that are considering joining a TradeLens' ecosystem and proposes how each of the three identified dimensions might address them.

The remainder of this paper is structured as follows: First, a general overview of blockchain technology is presented, in order to provide a basic understanding of the technology, outline main design decisions involved in building a blockchain system and describe key concepts of

[38] While several useful definitions of collaboration are provided in the literature (e.g. Gulati et al., 2012; Castañer and Oliveira 2020), the term "collaboration" here is primarily concerned with the willingness of shipping ecosystem actors to work together using TradeLens. This resonates with the argument of Zavolokina et al. (2019) that blockchain consortia are a new type of inter-organizational collaboration.

importance. The following two sections describe the issues in the shipping industry and discuss the applicability of blockchain in supply chains. The fifth section describes the difficulties and risks involved in building collaboration on a blockchain-based platform. Methodology section describes the process of data collection and analysis. The subsequent chapters discuss the findings in more detail. The discussion chapter summarizes the findings and provides a more detailed discussion about specific risks and control mechanisms. Finally, the conclusion and limitations of the study are provided.

2. Blockchain

Blockchain is a technology for recording and sharing transactional data across a network of independent actors in a transparent and decentralized manner (Xu et al., 2017). It is best known as the technology underlying Bitcoin, a purely peer-to-peer payment system, introduced in a whitepaper by Satoshi Nakamoto in 2008.

The term "blockchain" pertains to a chain of blocks, each containing multiple transactions (Nærland et al., 2017). Transactions in a given block are secured by the use of cryptographic hash functions, which compress the block into a string of digits of a pre-defined length. Hash values are unique, and any alterations of a block in a chain instantaneously change the hash value (Nofer et al., 2017). Every block is linked to the preceding block, because it contains the hash of the preceding block in addition to the actual hashed transaction data (Nærland et al., 2017). Since the blockchain is extended by every additional block, it represents a ledger of complete transaction history. In addition to hashed transactional data and the hash of the previous block, every block also contains a timestamp and a nonce, an arbitrary number for verifying the hash (Nofer et al., 2017). A blockchain is shared among a network of computers – known as nodes. The nodes are incentivized to reach consensus on the state of the blockchain. If the majority of nodes, by a consensus mechanism[39], agree about the validity of transactions in a block and about the validity of the block itself, the block is added to the chain (Nofer et al., 2017). All of the nodes on a Bitcoin network also hold an identical copy of the blockchain, meaning that if one of the nodes fraudulently changes its own version of the blockchain, that version would be dismissed by the other nodes. New entries can only be accepted if they adhere to a pre-defined protocol, making

[39] The consensus mechanism is the process by which a majority of network's validating nodes come to an agreement on the state of a ledger. It can be described as a set of rules and procedures that allows maintaining a consistent set of facts among multiple participating nodes (Swanson, 2015).

the blockchain secure (Nærland et al., 2017). Furthermore, because all the nodes hold an identical copy of the blockchain, the network can endure, even if individual nodes are hacked or corrupted (Nofer et al., 2017).

Bitcoin's blockchain is an example of a public, permissionless blockchain, in which all the nodes on the network can read the data, submit transactions and participate in the validation process (Peters and Panayi, 2016). There are, however, different iterations of blockchain. In the context of public permissioned blockchains, all the nodes can read the data and submit transactions, but only predefined nodes can verify transactions. Within private blockchains, such as enterprise blockchains, only pre-approved participants can read, submit or validate transactions (Nærland et al., 2017). Depending on the particularities of a given business case, practitioners who leverage the technology to develop new business models have relied either on all of its elements or have mobilized its distributed database, governance and algorithmic enforcement components (Kostić and Sedej, 2020). The designers of blockchain systems thus face several decisions, which in turn influence the system's functionalities. These design decisions are made on three distinct layers, namely the protocol layer, the network layer and the application layer. The protocol layer refers to the collection of core protocol frameworks that serve as building blocks of a blockchain system (Rauchs et al., 2019). The protocol layer does not create a lot of value in and of itself, and is very difficult to monetize on its own (Platt, 2017a). The network layer brings blockchain systems to life (Platt, 2017a; Rauchs et al., 2019). It consists of a group of interconnected actors that adhere to the protocol and participate in peer-to-peer sharing and validation of data, to produce a consistent single source of truth about the shared set of records. The application layer, sometimes referred to as data layer or business logic layer (Platt, 2017a; Rauchs et al., 2018), comprises business applications that create actual business value (Rauchs et al., 2019), and make a blockchain system useful (Platt, 2017a). Each of these layers can have different degrees of centralization. While the network and protocol layer could be controlled by a single entity, the application layer could be decentralized, allowing everyone to develop applications (Rauchs et al., 2018).

Figure 1 outlines key design considerations[40] involved in building a blockchain system, each of which will have implications on characteristics and properties of the system. Rather than treating

[40] Several different categorizations of design choices involved in building a blockchain system exist in the literature, ranging from high-level definitions (e.g. O'Leary, 2017), focusing primarily on rights of participation (i.e. private or public) and rights of validation (i.e. permissioned or permissionless), to a very detailed classifications,

these design decisions as binary, they should be seen as falling along a spectrum (Rauchs et al., 2018). For illustration, three prominent blockchain use cases (i.e. Bitcoin, Ripple[41] and TradeLens), are positioned along a spectrum of each design decision.

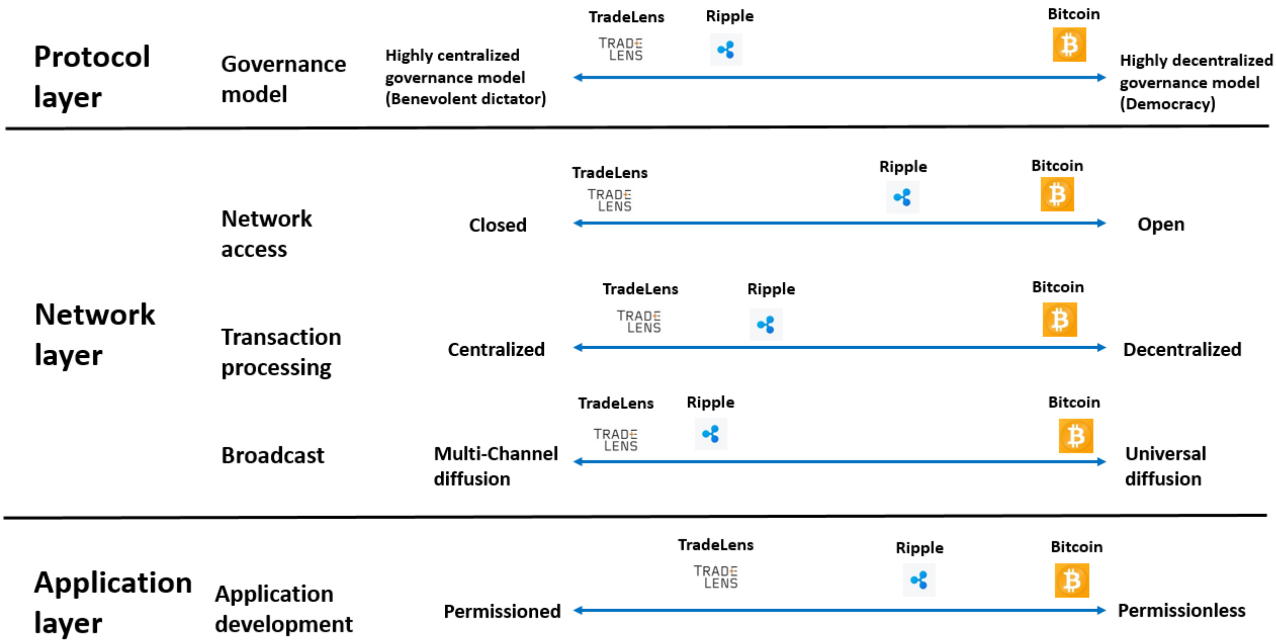


Figure 1: Key design decisions involved in building a blockchain system[42]

Blockchain systems use various governance models, ranging from benevolent dictatorships to democracies[43]. Democracies (e.g. Bitcoin and Ethereum[44]) are the most decentralized governance models, in which each participant gets one vote. On the other end of the spectrum, the founder of the blockchain system typically serves as a benevolent dictator, with full control over the mission and initial source code (Lacity et al., 2019). Founder-led blockchains are also the most prevalent type of blockchain networks in the current enterprise blockchain landscape (Rauchs et al., 2019). It should be noted, however, that the governance model normally evolves, as benevolent dictators decide to gradually move towards a more decentralized model, in order to drive adoption (Rauchs et al., 2018; Lacity, 2019; Rauchs et al., 2019). Network access determines the rights to connect to the blockchain network. If the access to the system is unrestricted, anyone can join and leave

outlining multiple design choices on distinct layers of blockchain systems, as well as interplay of various layers and subsystems nested within them (e.g. Rauchs et al., 2018). Figure 1 shows design decisions, particularly relevant when deploying enterprise blockchains.

[41] For more information on Ripple see https://ripple.com/

[42] Based on Rauchs et al. (2018) and Lacity (2019)

[43] Lacity (2019) outlines seven different governance models, namely benevolent dictator, Oligarchy, Stakeocracy, Federation, Representative meritocracy, Meritocracy and Democracy

[44] For more information on Ethereum see https://ethereum.org/en/

at any time. Restricted access on the other hand, typically requires a gatekeeper, granting access rights to interested entities. Some blockchain systems (e.g. Alastria[45]) use semi-open network access, where validator nodes vote on accepting new members (Rauchs et al., 2018). Transaction processing refers to a set of processes, specifying mechanisms for updating records on a shared ledger. It involves decisions on (1) Which actors are allowed to update the authoritative set of records (i.e. permissioned or permissionless); and (2) How actors reach an agreement on realizing these updates (i.e. consensus protocol) (Rauchs et al., 2018). The majority of enterprise blockchains employ permissioned transaction processing, where only pre-approved participants are allowed to update authoritative set of shared records. Bitcoin and Ethereum, on the other hand, allow every node on the network to participate in transaction processing. Ripple uses a semi-open transaction processing. While everyone can run a validator node on the Ripple network, transaction validators are grouped in unique node lists (UNL), and it is up to a given participant to choose a reliable set (Ripple, 2020). Broadcast determines how data is transmitted across a network of nodes. Data can either be broadcasted to every node on a blockchain system (i.e. universal diffusion) or distributed only to a particular subset of nodes involved in a particular transaction (i.e. multi-channel diffusion) (Rauchs et al., 2018). While universal data diffusion allows for perfect transparency (Platt, 2017b), enterprise blockchains, which typically include entities with competing interests, often opt for "selective transparency" and leverage a multi-channel diffusion model, thereby meeting the confidentially and privacy requirements of participating organizations (Rauchs et al., 2019). Finally, the application development decision determines who is allowed to develop applications on top of a blockchain system (i.e. on the application layer). Decisions on application development will have implications on the diversity of applications available on the data layer of the blockchain system.

Design decisions will influence the functionalities of the blockchains system, and determine the level of security, transparency, scalability, complexity and validation speed. Table 1 outlines the implications of design decisions, made on each of the three layers.

[45] For more information on Alastria see https://alastria.io/en/

Layer	Design decision	Implications on blockchain system characteristics
Protocol Layer	**Governance model**	• Decision-making • Ruleset • Sustainability/antifragility • Perceived legitimacy • Transparency • Outsider access • Efficiency and coordination
Network Layer	**Network access**	• Diversity of network participants • Trust requirements • Choice of consensus mechanism
	Transaction processing	• Transaction finality • Participation • System maintenance costs • Degree of tamper resistance
	Broadcast	• Privacy and confidentiality • Scalability • Complexity
Data Layer	**Application development**	• Participation • Diversity of applications

Table 1: Implications of key design decisions[46]

Because different design choices will result in different characteristics, designers should be aware of tradeoffs involved when building a blockchain system (Rauchs et al., 2018). The most often discussed tradeoff is that of attaining higher performance gains at the expense of lower decentralization (Rauchs et al., 2019). Early blockchain systems, such as Bitcoin for instance, prioritized censorship resistance and trust minimization, which necessitated high levels of decentralization on all layers. This resulted in slow confirmation speed, scaling limitations, high energy costs and inefficient redundancy. Enterprise blockchains, on the other hand, normally opt for a more centralized and closed system (only allowing access to approved participants), which typically results in faster speed, higher efficiency and lower costs (Rauchs et al., 2018). A higher level of centralization, however, will likely reduce overall security and tamper-resistance of the system (Platt, 2017b; Rauchs et al., 2019). When considering design choices, there is no universal "right" or "wrong". Blockchain systems are designed to serve a specific objective, according to the requirements of particular use case. This objective guides design choices, and determines acceptable trade-offs (Rauchs et al., 2018).

The following section outlines the issues within the shipping industry, caused by inefficient information exchange, and proposes how a shared information infrastructure could address them.

[46] Based on Rauchs et al. (2018)

3. The Shipping industry and shared information infrastructure

The shipping industry has traditionally relied on the physical movement of large amounts of paper documentation, which opens up the possibility of delays, human error and fraud. Stokel-Walker (2017) for example, estimates that the yearly cost of maritime fraud amounts to $600 billion. In addition, information in the shipping industry is disseminated across a multitude of disparate actors. Almost every supply chain actor, such as carriers, ports, terminal operators and custom offices, has their own information system and different formats (e.g. EDI, e-mail, fax) with which to exchange documents following the physical shipment. Because more than 30 organizations can be sharing data or documents in a single shipment (Jensen et al., 2018), large amounts of data in diverse formats are produced. The resulting complexity presents a challenge for inter-firm coordination, creates operational delays, and involves high costs, as the processing of trade documentation can be even more expensive than moving an actual shipment (World Economic Forum, 2017). Even though information covering each aspect of the shipment journey typically already exists in a digital format, it is normally stored in each organization's local IT system (Jensen and Vatrapu, 2015; Jensen et al., 2019). This culminates in fragmented and limited exchange of information (Clement and Wagner, 1995), resulting in uncertainty about lead times and current states (Jensen et al., 2018).

To address these issues, Jensen and Vatrapu (2015) and Jensen et al. (2018) proposed an information infrastructure, shared between various actors in global supply chains. They see such an infrastructure as a way to decrease transaction costs, create transparency, improve security and decrease the number of inspections through improved data quality. Figure 2 outlines contemporary challenges in global supply chains, and how a proposed shared information infrastructure could solve them.

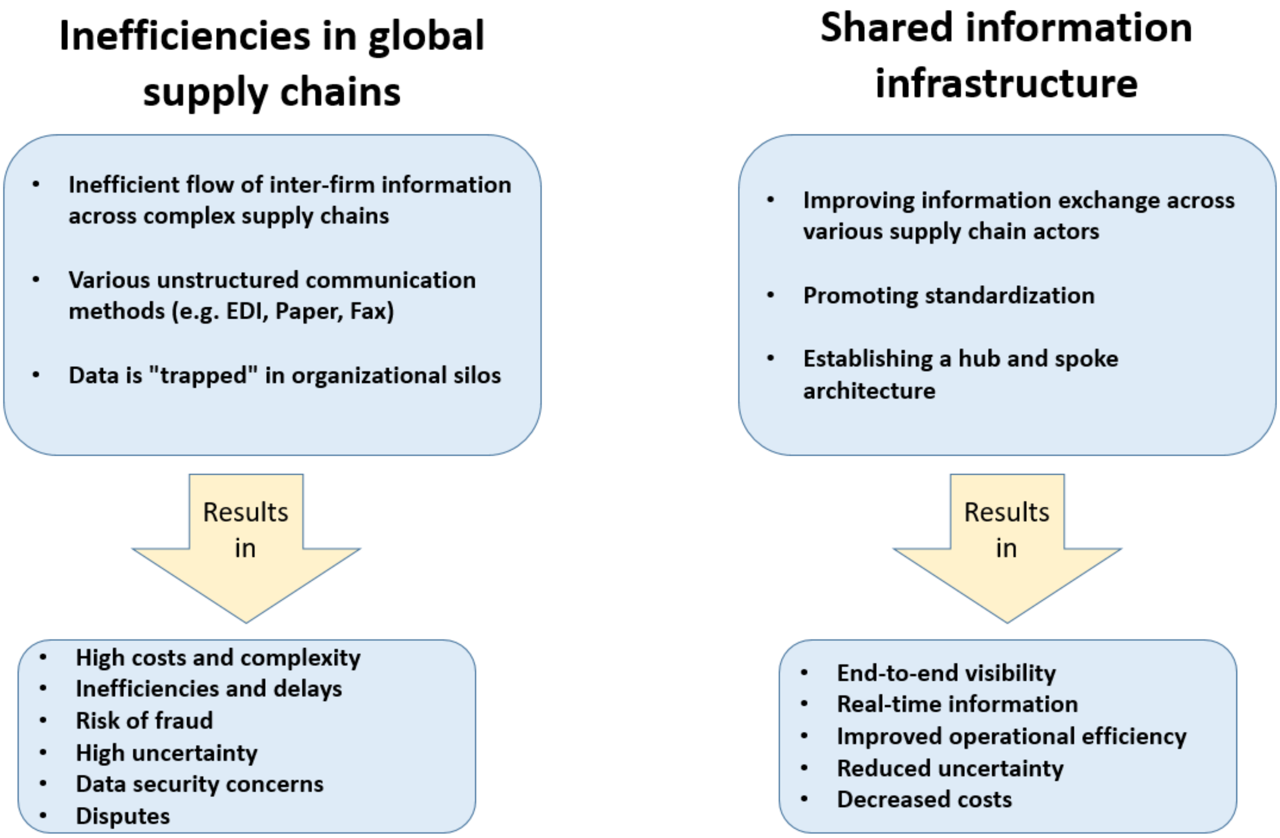


Figure 2: Inefficiencies in global supply chains and how a shared information infrastructure could solve them[47]

Building a shared information infrastructure, however, requires contributions from different actors with diverse and sometimes conflicting perspectives and goals (Chen et al., 2020). This introduces risk in building collaborative ecosystem solutions, as opposing interests can result in decreased commitment that gradually deteriorates the relationship (Doz, 1996). Sharing sensitive data can also increase the potential for information misappropriation (Baiman and Rajan, 2002), and make firms vulnerable to opportunism by relationship partners (Christ and Nicolau, 2016). Because of this risk, actors in global supply chains are reluctant to share any kind of sensitive information, especially through technology suggested by a rival (Jensen et al., 2019). In addition, transaction partners who are also competitors can more easily recognize and assimilate information and resources of value to them (Grafton and Mundy, 2017), meaning that safeguarding the data shared on an industry-wide information infrastructure is a critical consideration.

[47] The figure is based on Jensen and Vatrapu (2015), Jensen et al. (2019) and Nærland et al. (2017)

Because of high data security requirements, a centralized database may not be best suited for building an industry-wide information infrastructure (Lind et al., 2020). While a centralized solution with high-level encryption could potentially provide acceptable security, it would also raise concerns of who is in control of the shared data (Jensen et al., 2019). As such, mobilizing blockchain technology, with its distributed architecture, and the promise of security, transparency and tamper resistance might seem like a particularly suitable option for building a shared information infrastructure. Compared to traditional databases, blockchains provide a novel solution to control (Coyne and McMickle, 2017), and offer to solve the trust problem in inter-firm contexts by moving some of the problem complexity from the organizational to the technical level (Beck et al., 2016; Catalini and Gans, 2016).

4. Blockchains in supply chains

Because enterprise blockchains are perceived as solutions that establish common data standards across organizations, bridge organizational silos, and facilitate record reconciliation (Rauchs et al., 2019), implementing blockchain technology for resolving issues in complex supply chains, involving multiple organizations, seems like a particularly good fit. This is perhaps why a number of authors view enterprise blockchains as a potential solution to solve problems within global supply chains. Schmidt and Wagner (2019), for example, suggest that blockchain could reduce the transaction and governance costs of supply chain transactions by decreasing the costs of search and information and the costs of post-contractual control, as an immutable ledger would allow actions and performance tracking of the contract partner. Similarly, Lumineau et al. (2020) suggest that data integrity and reliability, enabled by the blockchain, can allow for better detection of opportunism while reducing monitoring costs. Crosby et al. (2016) and Korpela et al. (2017) further argue that blockchains can create transparency by providing reliable real-time and historical data, facilitating secure corporate data warehousing and enhancing information sharing between business partners.

The characteristics such as security, immutability and transparency, however, will depend on design decisions made while building a particular blockchain system. Universal data diffusion, for instance, would allow for complete transparency (Platt, 2017b), and enable anyone to audit transactions, which could discourage actors from behaving opportunistically. Yet, because of competing interests, firms are unlikely to agree to universal diffusion of proprietary data, meaning that the majority of enterprise blockchains will likely adopt a multi-channel diffusion model instead (Rauchs et al., 2019). Similarly, because of confidentiality requirements, enterprise blockchains will likely opt for a closed network access, and only allow vetted participants to join. Closed network access, however, will result in less participants holding a replicated copy of the ledger, therefore diminishing the "cockroach-like" resiliency of having several hidden actors maintaining integrity of the data, inherent to Bitcoin (Platt, 2017b). Yet other often-assumed characteristics of blockchain systems are their security and immutability (e.g. Iansiti and Lakhani, 2017). These characteristics, however, will likewise depend on several design decisions, such as network access, data broadcast and transaction processing. In Bitcoin, Proof-of-work[48] consensus mechanism prohibits retroactive alterations to the blockchain, by necessitating that a dishonest actor out-computes all other participants in the network. However, if a dishonest actor (or a group of dishonest actors) held 51% of computing power, it would be able to alter the records on the blockchain (Coyne and McMickle, 2017). Because enterprise blockchains are often controlled by a small group of companies (or a single company), solely responsible for transaction processing, this can pose a threat to other participants entrusting their data to the network. If this group of companies (or a single company) had full control over transaction validation, it would be able to alter any portion of the blockchain (Rückeshäuser, 2017), making data manipulation possible. Additionally, when leveraging blockchain to record and exchange information in supply chains, one should be aware of the exogenous nature of the data exchanged. Unlike cryptocurrencies, which only exist within the blockchain, economic transactions and supply chain events exist outside the blockchain system (Coyne and McMickle, 2017). While asset ownership might be verified by blockchain records, its condition, location and true worth must still be assured (ICAEW, 2017).

Because design decisions play a central role in determining the level of security, transparency and control over the shared data, they will likely be a critical in influencing the willingness of various supply chain actors to engage in collaboration on the blockchain platform.

5. Difficulties of building collaboration

Establishing collaboration is critical when building an industry-wide ocean shipping platform given the high degree of interdependence between members of this complex ecosystem (Güven-Koçak, 2015). Stakeholders in the shipping industry are highly dependent on each other for the

[48] Proof-of-work is form of cryptographic zero-knowledge proof, used in Bitcoin. See https://cointelegraph.com/explained/proof-of-work-explained

flow of information, and collaboration between them is key to ensure smooth operation of chain of logistics (Pradi, 2020). Actors in this highly competitive industry, however, are reluctant to engage in collaboration and tend to only authorize data sharing when it is in their self-interest (Lind et al., 2020). This may be one of the reasons why some of the world's largest ocean carriers initially dismissed TradeLens as "unusable" (Allison, 2018). Although Mærsk's competitors recognized the benefits of an industry-wide platform, they were skeptical about joining the initiative proposed by a competitor. The Head of Strategy and Operations at GTD Solution described these concerns: "*The incentive to join was clear from day one. And even when they [competing carriers] were publicly against TradeLens, companies like Hapag-Lloyd, their CEO publicly said, "No. We are convinced of the merits of a TradeLens-like platform. We just need to be convinced of the specific implementation*."".

TradeLens is not the only platform within the industry using blockchain technology. In early 2020 CargoSmart, a logistic tech firm, announced that nine global ocean carriers and terminal operators signed a shareholders' agreement for the Global Shipping Business Network (GSBN[49]), a non-profit organization, with the intention to digitize shipping supply chains. Among the GSBN members are also Hapag-Lloyd, CMA-CGM and port operator PSA, who are also members of TradeLens (Ledger Insights, 2020). The existence of this overlapping partnership, as well as data collected through interviews with TradeLens ecosystem partners, indicate that competing ocean carriers, as well as other ecosystem members are still considering different alternatives. Zajac and Olsen (1993) categorize these early considerations as "initializing stage" of an inter-organizational exchange process, during which individual firms engage in constructing net present value assessments of alternative exchange relationships. These assessments involve many elements, including hazards involved in transactional relationships.

Consistent with transaction cost theory (Williamson, 1985), many studies (e.g. Shelanski and Klein, 1995; Anderson et al., 2000) use transaction properties (i.e. uncertainty, asset specificity, size, frequency, interdependence) as a proxy for transaction hazards in exchange relationships (Anderson and Dekker, 2005; Anderson et al., 2014; Anderson et al., 2015). Several of these characteristics could be useful for analyzing transaction hazards pertinent to TradeLens case as well. There is, for instance, a high degree of uncertainty related to the development and commercialization of new technology (Teece, 1992), such as blockchain. Actors in global supply

[49] GSBN is a blockchain-based shipping platform, developed by CargoSmart. See https://www.cargosmart.ai/en/solutions/global-shipping-business-network/

chains have traditionally been seeking productivity gains by focusing on their own individual efficiency improvements, rather than on synergistic advantages from the ecosystem (Jensen et al., 2019). Blockchain solutions, however, are designed to solve inter-organizational challenges (Jensen et al., 2019; Van Hoek and Lacity, 2020), and, as such, have to be shared with other ecosystem participants (Lacity, 2018), often including competitors. Since transaction partners usually only have partially overlapping goals (Ouchi, 1980), their cooperation cannot be taken for granted (Das and Teng, 1996). Partners enter a transactional relationship in pursuit of the long-term self-interest. Interests, however, can change during the course of the relationship, giving rise to opportunism (Vosselman and van der Meer-Kooistra, 2009). Because of the uncertainty related to partners' future behavior (Parkhe, 1993) actors in supply chains are hesitant to share proprietary data, as this could result in leakage of valuable intellectual property (Teece, 1986; Oxley, 1997). This is particularly relevant for exchanging information and know-how, since they are easy to duplicate and transfer (Doz et al. 1989).

Asset specificity is another transaction characteristic, which could help explain initial concerns of supply chain actors to adopt TradeLens. Adopting a blockchain-based platform (either TradeLens or GSBN) requires investments in transaction-specific capital (e.g. integrating legacy systems with the platform, end-user training). Transaction-specific capital, however, has little or no value outside the specific transactional relationship for which it was made (Klein et al., 1978). The risk for a particular party, an ocean carrier for example, is that it will invest its resources in one of the shipping blockchain platforms, while in time, another platform emerges as a de-facto industry standard. Because of this risk potential platform users often delay adoption, fearing that they will be left with obsolete investments if they back a losing platform (Eisenmann et al., 2006). Moreover, returns on such sunk capital can often be appropriated by other parties (Clemons and Row, 1992; Shelanski and Klein, 1995). It is therefore important for firms to safeguard their investments in relationship-specific assets in order to limit opportunism and create value (Dyer and Singh, 1998; Grafton and Mundy, 2017).

While using transaction characteristics as indirect indicators of transaction hazards might be seen as useful for analyzing the TradeLens case, this approach has also been criticized for neglecting specific risk exposures, thereby limiting our understanding of how risks give rise to management controls more broadly defined (Anderson et al., 2014; Anderson et al., 2015). In addition, studies based on transaction cost economics mainly focus on governance mechanisms that mitigate relational risk (Anderson et al., 2014). Relational risk refers to the concern that partner companies might not work towards mutually agreed goals, as specified in alliance arrangement (Das and Teng, 1996). A number of studies (e.g. Zajac and Olsen, 1993; Madhok and Tallman, 1998; Malhotra and Lumineau, 2011), however, observe that relational risk is neither the only, nor the most crucial risk in alliances (Anderson et al., 2014). Another type of risk inherent to IOR is performance risk, which refers to the hazard of not achieving joint goals, despite full cooperation by all partners (Das and Teng, 1996). In several collaborative relationships, value creation and performance considerations are generally seen as bigger concern for managers than relational risks, related to opportunism and value misappropriation (Zajac and Olsen, 1993; Anderson et al., 2014).

Because decision makers consider both potential gains as well as potential losses to estimate risk (Das and Teng, 1996), identifying both the proposed value, as well as outlining specific hazards facing potential TradeLens adopters can allow for better understanding of the factors that influence their decision to join the platform.

6. Research Methodology

The primary objective of this paper is to identify the factors influencing the decision of various supply chain actors to engage in inter-firm collaboration and start sharing data through TradeLens. To accomplish that, the broad goals were to (1) Identify perceived risks and benefits for potential adopters, and; (2) Explore how Mærsk and IBM attempt to incentivize partners to join TradeLens.

Because the early stages of creating a blockchain-based ecosystem are relatively unexplored in the literature, this paper follows a qualitative approach (Edmondson and McManus, 2007; Dattee et al., 2018). Qualitative data is a source of well-grounded, rich descriptions, and is able to explain processes in identifiable local contexts (Miles and Huberman, 1994). It can focus on particular issues of organizational life, and address specific experiences (Cassell and Symon, 1994). The researchers however, should be aware of issues with using qualitative data, such as data overload, generalizability of findings and the credibility of conclusions (Miles and Huberman, 1994). Collis and Hussey (2013) also stress the importance of retaining the integrity of collected qualitative data, and emphasize that the way in which the data is collected must be systematic and methodical. This study tried to minimize these concerns by using multiple sources of evidence, joint interviews, reviewing results with peers, allowing participants to review the results and following a structured process.

A case study strategy is used in this paper. Robson (2002) defines a case study as a strategy for doing research, involving an empirical investigation of a particular phenomenon in depth and within its real life setting. Yin (2009) also stresses the importance of context, and suggests that in the case study, the boundaries between phenomenon and its context are not clearly evident. Because an industry-wide collaboration on a blockchain-based platform is a novel phenomenon, this case study was designed as exploratory. Based on early data collection and the initial literature review, transaction cost theory (e.g. Williamson, 1985) was found to be promising for analyzing TradeLens case. Concepts from transaction cost theory, including opportunism, uncertainty, asset specificity and information asymmetry seemed particularly suited for explaining the initial reluctance of ocean carriers to join the platform, launched by one of their rivals. The questions for the following round of interviews were therefore in part based on these concepts. Yet, as more data was collected, it became evident that transaction cost theory alone would be insufficient to fully understand all the factors influencing ecosystem actors' decision to join TradeLens. Because IORs among networks of firms are a complex phenomenon, researchers can apply different theoretical perspectives to study them (Dekker, 2004). This is particularly true when IORs are examined in combination with another complex phenomenon, such as blockchain (Kostić and Sedej, 2020). Subsequent data collection further guided the choice of theory, and the interview guide was expanded with questions derived from broader literature on IORs, information system literature and literature on digital platforms. Such an approach has been referred to as "abduction" (Peirce, 1931). It is a process in which empirical fieldwork, theoretical framework and case analysis develop concurrently. The initial framework is continuously adjusted, both as a result of unexpected empirical findings, and theoretical insights attained during the process. The abductive approach can result in useful cross-fertilization in which new combinations are created through amalgamation of well-established theoretical models and new concepts derived from empirical data (Dubois and Gadde, 2002).

6.1. Data collection

Data was collected from several sources: (1) in-depth semi-structured interviews; (2) participation at industry conferences and live webinars; (3) informal talks with individuals involved with TradeLens; and (4) secondary data including TradeLens' documentation, industry reports, industry conference presentations, news articles and press releases. Rich data collected from multiple sources allowed for triangulation of data and enhanced the robustness of the findings

(Eisenhardt, 1989). When conducting in-depth semi-structured interviews, the researcher had a list of theory-based questions and themes to cover, but did not follow a rigid order of questions and allowed interviewees to describe the phenomenon in their own terms and their own viewpoint (McCracken, 1988; Kvale, 1996).

Natural or convenience sampling (Collis and Hussey, 2013) was used in this study, because the choice of participants was influenced by interviewees' roles within their respective companies and their involvement in TradeLens. Data was collected at several large companies, including large ocean carriers (Mærsk, MSC and PIL), a technology provider (IBM), container terminals (GCT terminals and APMM terminals) and a customer (AB InBev). The majority of respondents held senior positions within their respective companies (e.g. CEO, CIO, CTO, VP). They were chosen, because they would be able to provide a high-level view of the decision-making process, and discuss benefits and concerns of potential TradeLens adopters. Another criterion for selecting interviewees from TradeLens ecosystem partners was that they were involved in the decision process regarding joining the platform. In order to verify the accuracy of the analysis and interpretation, repeated interviews were conducted with a Digital product manager at Mærsk. Repeated interviews also allowed crosschecking information collected from other respondents and secondary data.

The data collection for the study spanned the period of May 2018 until September 2020. To gain a preliminary understanding and overview of the TradeLens project, initial exploratory interviews with Mærsk and GTD Solution/TradeLens were conducted during 2018. Although TradeLens went live in December 2018, and despite all the potential upsides of an industry-wide shipping platform, the ecosystem adoption of TradeLens remained sluggish. Consequently, during 2019, additional interviews were conducted with Mærsk, and a sample of other industry participants, to try and understand the reasons for the slow uptake. During these interviews, particular attention was paid to the factors holding back widespread adoption, and exploring how the two founding companies intended to address them. In addition, an interview with a prominent shipping industry analyst was conducted, in order to obtain an external perspective on the issues within shipping sector in general, as well as specific concerns related to digital platforms in the industry. In early 2020, additional interviews were conducted with ecosystem participants (including terminals, ocean carriers and a customer). As these interviews were conducted, particular attention was paid to identifying and understanding: (1) The concerns of industry actors related to TradeLens membership and; (2) The factors that would incentivize them to adopt the platform. Appendix B provides an overview of the interviews conducted.

Interviews were recorded and transcribed. In addition, very detailed notes were taken during and immediately after each interview. This resulted in roughly 21 hours of recordings, over 230 pages of transcripts and 95 pages of notes. In addition to formal interviews, several informal talks were held with individuals involved in TradeLens initiative. These include the CEO of GTD Solutions/TradeLens, Head of Digital Business Solutions at Port of Rotterdam (a TradeLens participant), and the CIO of Hapag Lloyd AG (fifth largest ocean carrier). These informal talks further influenced subsequent data collection. One respondent, for example, noted that that his company intended to join TradeLens, if interoperability between TradeLens and other shipping platforms would be ensured. Based on this observation, questions on interoperability were included in the interview guide. Aside from the interviews and informal talks, data was collected through participation at industry conferences and live webinars. Appendix C maps these events.

In addition to primary data, secondary data was collected to complement and verify interview data and data collected at industry events. Discrepancies between interview data and secondary data opened new questions, which guided subsequent data collection and analysis. For example, a news article in 2018 (Allison) indicated that Mærsk and IBM were struggling to attract other ocean carriers, which was not evident from the initially collected data. In light of this development, the researcher sought to explore the causes of this issue in the subsequent interviews with Mærsk, as well as started to contact other ecosystem actors to identify their concerns. Secondary data used in this study are TradeLens' documentation, industry reports, industry conference presentations, news articles and press releases. Appendix D provides an overview of secondary data sources.

6.2. Data analysis

Interviews were transcribed and coded using constant comparative analysis (Strauss and Corbin, 1990; Glaser and Strauss, 2017). As the research developed and new data was collected, identified categories were continuously compared to previous data. When new data produced new or contradictory information, the categories were adjusted, to take these new developments into account. This process was repeated until no new categories were emerging and no new information was inconsistent with existing categories (i.e. until theoretical saturation was reached) (Strauss and Corbin, 1990; Browning et al., 1995; Glaser and Strauss, 2017). Constant comparative analysis involved data triangulation, by crosschecking statements across informants and verifying them against secondary data. Initial open coding produced 23 codes describing factors that influenced the decision of shipping ecosystem actors to join TradeLens. As the researcher cycled between data collection, coding and existing theory, initial codes were aggregated into seven higher-level categories using axial coding (Strauss and Corbin, 1990). These were in turn synthesized into three dimensions, namely Value Creation, Governance and Interoperability. The data structure that resulted from this iterative analysis is presented in Figure 3.

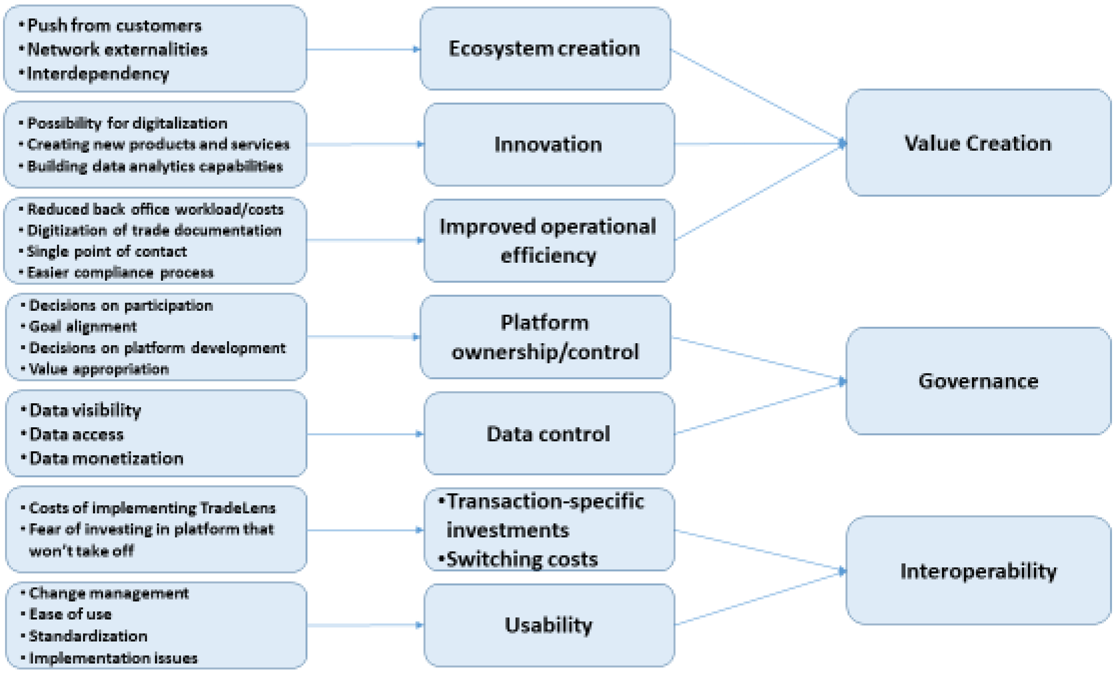


Figure 3: Data coding and structure

The value creation dimension is mainly concerned with enabling factors to TradeLens adoption, such as positive network externalities, possibilities for digitization and innovation, and improved operational efficiencies. The governance dimension on the other hand, primarily deals with inhibiting factors to adoption, such as losing control over data, value misappropriation and misaligned interests. While it could be argued that the concept of interoperability is more operational than value creation and governance, and could perhaps be a part of either of the two elements, it is here treated as a separate construct. This is because interoperability has been found to affect both the efficiency of the solution, as well as risks related to asset specificity. First, various interviewees noted that GTD Solution could significantly speed up the adoption process if it managed to onboard the largest customers (e.g. AB InBev, P&G, US Military), because large clients use different carriers, and a large customer base using TradeLens would “push” other ecosystem actors to adopt the platform. Later, an interview with a respondent from AB InBev (Customer) revealed that usability of the platform and simplicity of integration with their legacy systems are crucial elements influencing their decision to adopt TradeLens. Second, collected data indicates that there is still uncertainty related to the “winning platform”, and several interview participants indicated to believe that more than one blockchain-based shipping platform will exist in the future. As such, interoperability between TradeLens and other blockchain platforms significantly influences the decision of supply chain actors to join TradeLens, because of the expectation of reduced switching costs, and of decreased risk related to asset specificity. The following sections discusses each of the dimensions in more detail.

7. Value creation

In order to drive adoption, TradeLens needed to demonstrate the business value of its proposed solution. As the quote above attests, the financial value of TradeLens, derived from decreased administrative costs was evident to players in the shipping industry. A report by United Nations’ Economic and Social Commission for Asia and the Pacific (UN/ESCAP) estimates that a region-wide cross-border paperless trade would generate more than $257 billion in additional trade annually (ESCAP, 2014), as companies would be able to redirect their efforts from handling burdensome administration to more value adding activities. Digitizing trade documentation would also reduce the possibility of loss or destruction of data and substantially speed up information exchange at a fraction of the cost (Jensen et al., 2019). Moreover, introducing a blockchain in such a platform could help further diminish operational delays and alleviate security concerns, as the resulting transparency can reduce the potential for fraud and error, and significantly reduce transaction costs and delays in settlements (Lumineau et al., 2020). Through higher informational efficiency, such an industry-wide platform should provide strong incentives for key stakeholders to join the ecosystem (Luo, 2006). A key consideration for ocean carriers however, is that of joining this particular platform, launched by one of their competitors, instead of a competing one, such as GSBN.

7.1 Focus on the end-to-end journey of the container

One of the value propositions of TradeLens, as compared to other shipping platforms, is its focus on the end-to-end journey of a container, which on average, involves approximately 30 organizations, such as ocean carriers, ports, terminals, governmental authorities, and inland transportation providers (Jensen et al., 2018). Other shipping platforms are typically more limited in the scope of the ecosystem they are trying to address, focusing specifically on communication between ocean carriers and shippers. The Project Lead at Global International team at Anheuser-Busch InBev explains this issue: "*That's exactly the problem because platforms such as INTTRA, GTN or CargoSmart, for example, are communication platforms between us as a shipper and our freight provider or carrier. There's no other supply chain party posting data in these platforms. So these platforms have a lot of data, but the data are only coming from the carriers or shippers. That's where most of the platforms are still failing today - they don't have the full ecosystem, all of the supply chain or cargo transport participants under one platform*." Additionally, the involvement of all the actors involved in a container journey would help alleviate the invoicing concerns, which characterize contemporary supply chains. The Vice President of Blockchain Solutions at IBM described these problems: "*If you move containers from one part of the world to the other, you've got to pay a bill. The bill is made up of multiple parts. You've got to pay the inland trucking lanes on either end, you've got to pay the ocean carrier, you've got to pay the port for storage of the container. So, the bill is pretty hard to understand. Moreover, you have no idea whether you're paying for the right services. With TradeLens you could see that [the container] was at this port for this many days. It was on this bunker journey at this point in time, bunker oil surcharges were at this point in time. So, just tracking that helps you deliver a better invoice".*

TradeLens demonstrated the ability to grow the ecosystem quicker than its competitors. Since Mærsk, the biggest ocean carrier in the world, was the initiator of the TradeLens project, it was able to use its dominant market position to onboard downstream and upstream members of the value chain, which is common in the deployment of founder-led blockchain networks (Rauchs et al., 2019). Interview data indicates that while competing ocean carriers were initially reluctant to join TradeLens, there was a considerable appetite from other actors in the ecosystem to adopt the platform. These parties saw TradeLens as a way of obtaining better, timelier and more accurate information, which would lead to significant increase in their operational efficiencies, reduce their costs, and open up possibilities for digitization and digitalization. Certain parties (i.e. terminals) joined, because the request came from their customers (ocean carriers). Several respondents also noted that maintaining a single interface with a number of different actors in the ecosystem will simplify their operations. President and CEO of Global Container Terminals Inc. noted: "*[The benefit of TradeLens is that] we only need to connect to the platform and all the shippers need to* *connect to the platform versus us connecting to each of the 15 shippers directly, which costs a lot of money, takes a lot of time and does not create a lot of value*". Interviewees from Mærsk and IBM noted that this initial interest contributed to perceived value of TradeLens network in two material ways. First, the expanding ecosystem created an incentive for ocean carriers to join the network, which several of their customers and partners were already a part of. Second, large members of TradeLens were able to leverage their own networks to onboard new members, since they were able to realize more benefits, if more of their partners used the same platform.

Albeit the many interviewees viewed TradeLens' ambition to focus on an end-to-end journey of the container and connecting the entire ecosystem as its main value proposition, some respondents warned of high levels of complexity associated with such undertaking. A CEO and Partner at SeaIntelligence Consulting, observed that "*One platform that does everything for everybody will never exist, because the variation in what different stakeholders need basically prevents one solution that fits all. There is a tradeoff involved in creating an industry-wide solution - you either need to leave something out, or make it phenomenally complex"*.

Another important step in initial development of the network was the early inclusion of customs authorities. A number of interviewees see these partnerships as both essential and mutually beneficial. By joining TradeLens, authorities can obtain the required documentation in an efficient, standardized and reliable manner. Since TradeLens is underpinned by blockchain, authorities can benefit from tamper-evident log of transactions, creating a reliable audit trail. As the Lead IT architect at GTD Solution/TradeLens points out: "*Governments are interested in any and all data that they can get in order to facilitate trade and sort out the bad guys and claim their revenue. So we plan to be an enabler of data for regulators*". In addition, he argued, customs authorities can benefit from needing to maintain a single interface (i.e. with TradeLens), for all members that are already onboarded to the platform. Partnerships with customs authorities can also create an incentive for firms to join TradeLens, because customs inspections are often viewed as a major source of inefficiencies in global supply chains. An example was given by a Project Lead at Global International team, Anheuser-Busch InBev, "*The stamp [on documents for some customs authorities] has to be in black ink. If it's in blue, they don't accept it. All of this takes a lot of effort for a shipper to remember, and we sometimes forget to put the ink in black and they seize the container. The container is stuck in the port, where we pay $150 storage a day. We need to send them a new bill of lading but via post. So, you can already do the math how much this little mistake will cost us. If we have a functioning and trusted platform in place, the amendment* *of the bill of lading is immediate. It's within minutes, not days, so issues like this will not exist anymore. That's where we will save the money*".

While there seems to be a consensus across respondents that inclusion of customs authorities will create considerable value for the network as a whole, some interviewees noted that getting more of them to join, might present a challenge. The reason is that several customs authorities require original paper documentation, including stamps and signatures. One respondent also noted that adopting a global platform is largely a political decision, because many governments are skeptical of sharing data through a platform, which other (competing or adversarial) governments are also a part of.

7.2. Enabling innovation through digitization

Through digitizing the shipping ecosystem (i.e. digitizing trade documentation, enabling real-time information and automating multi-party interactions), TradeLens intends to improve participants' ability to create value in new and innovative ways. As Chief Digital and Information Officer (CDIO) at Mediterranean Shipping Company (MSC), observed: "*I think by digitizing or digitalizing, we can bring a little bit more value, maybe monetize different things that we're not doing today and overall being more efficient. We could even aggregate some data from the platform and improve it*".

Informants from Mærsk and GTD Solution suggest that accurate, reliable and near real-time information can be used by TradeLens ecosystem members to build advanced data-analytics capabilities, and improve their internal planning systems, which can result in reduced uncertainty in regards to availability of goods, and in turn improve their capacity to serve their clients. Aside from improved customer service, better planning can also enable ocean carriers to reduce costs related to moving empty containers. As observed by the Vice President of Blockchain Solutions at IBM: "*Carriers move a lot of empty containers from one part of the world to the other. To solve that optimization problem, the industry loses tens of billions of dollars. So, data that's flowing through TradeLens will be valuable for that too, because it just tells you the total location of all the containers that's available globally*". Respondents also noted that digitizing trade documentation can lead to decreased costs of compliance, as TradeLens ensures that documents are standardized and compliant with current rules and regulations of particular jurisdictions. This might be particularly valuable for smaller players, who might not necessarily possess sufficient resources to adjust their documentation to changing demands from regulators. As a Digital product manager at Mærsk pointed out: "*When regulation changes, and if you are [a] mom and pop store, how do you know what kind of regulation you find around shipping something? If suddenly you start producing a new product? How will you know what kind of documentation is needed? Is it dangerous goods? Do you need a veterinarian? What about the EU regulation? Is that different from the US? All that stuff. A lot of this is outsourced to other parties. But if you can then get on a platform, where all this is already handled, then, you know, things change*".

It should be noted, however, that firms that fully entrust their compliance processes to a relationship partner might become exposed to compliance and regulatory risk. This is the risk of a firm being vulnerable to sanctions of external parties, because of lack of compliance of its relationship partner (Anderson et al., 2014). There also seems to be some uncertainty and potential compliance risks related to the electronic Bill of Lading (BoL), which is considered a central document in global container shipping. Respondents from PIL described this concerns: "*The risks still remain with legal concerns over the title transfer, such as the Bill of Lading. It is pivotal to ensure that all parties involved undertake full legal compliance to ensure the authenticity and uniqueness of the document. As such, the platform needs to make sure that there will only be a single "transferable" document at any one point in time. Similarly, its ownership, from its creation to expiry, should be controlled by only a single party throughout the entire process*". While several interviewees see blockchain, a technology whose primary aim was to prevent double spending, as an ideal solution for digitizing BoL, some critical issues remain unresolved. Liu (2020), for instance, suggests that contract clauses, dealing with every eventuality that could occur during container transport, cannot be incorporated into blockchain architecture. An electronic BoL would likely be based on a smart contract, which takes away a lot of flexibility. In contrast to self-implementable smart contract, actors in the "real world" can adapt when things go wrong (The Economist, 2016).

7.3 Marketplace

TradeLens offers an open applications and services marketplace, which allows both TradeLens and third parties to build fit-for-purpose services atop the platform. Marketplace is an example of relation-specific asset, through which TradeLens can co-create value with third-party developers (Grover and Kohli, 2012). The notion of value co-creation was echoed by a quote by the Head of Strategy and Operations at GTD Solution/TradeLens, who suggested: "*We're not going to have all of the ideas and certainly there are some things that we can't do, like financing for example.*

But we can facilitate those activities through TradeLens. And so if we're successful, somebody could come to TradeLens and never actually pay TradeLens money directly. It would be going to those application providers that are providing those services". This suggests that TradeLens' marketplace leverages a platform business model, facilitating interactions in a two-sided market among producers (third party developers) and consumers (supply chain actors and customers) (Parker et al. 2016).

There are currently three applications available on the marketplace. The first is TradeLens Core, a supply chain management tool, which captures shipment information and delivers it to relevant ecosystem participants via API or user interface. The second application is electronic Bill of Lading, which is an electronic version of a legal document between a shipper and a carrier that specifies the type, quantity and destination of the goods. The third application is a Bill of Lading verifier, which is tailored specifically for banks and other financial institutions, enabling more effective trade finance processes. These applications are expected to become the main source of TradeLens' revenue. While TradeLens developed the three initial applications, opening the marketplace to external developers can create two-sided network effects (Parker and Van Alstyne, 2005), where the value of a platform to a given user on one side of the platform, depends on the number of users on the other side (Eisenmann et al., 2006; Parker et al. 2016). As TradeLens onboards more and more participants, the platform could become increasingly attractive for developers. The Vice President of Blockchain Solutions at IBM described these considerations: "*Third parties will come in simply because, "Hey, you guys have gathered an ecosystem of network members and clients and you're just pumping data through the system, how can I add value to let's say a shipper, by giving them a better invoice dispute resolution solution?" The raw data can be used in various ways, and that is where third parties come in to deliver value*".

Two-sided network effects can also work in reverse direction (Eisenmann et al., 2006). The more developers start offering their services on the platform, the more attractive the platform becomes to participants. This could be particularly true for solutions targeting particular problem areas of specific participants. Such solutions may create a unique incentive for those parties to join the TradeLens ecosystem. As noted by the President and CEO of Global Container Terminals Inc.: "*If the TradeLens Marketplace will become an economic clearing hub for rail volume consolidation or truck volume consolidation, and through that, they will reduce price to our customers, the shippers, we would want to be a part of that*".

Additionally, because TradeLens does not extract any rents from developers, they should be incentivized to think of new and innovative ways to tackle challenges in the shipping ecosystem, and continually contribute to the usability and versatility of the platform. Developers can often bring in new ideas that the platform owner has not considered and resources that the platform owner does not control (Parker and Van Alstyne, 2018). Platform providers for two-sided networks can typically extract rents from both sides, although they often decide to subsidize specific parties (Parker at al., 2016). Two-side networks normally have a subsidy-side, and a money-side. If a platform provider can attract a sufficiently large number of subsidy-side users, the users on the money-side will pay generously to reach them (Eisenmann et al., 2006; Parker and Van Alstyne, 2018). This is why platform owners typically set prices for subsidy-side users lower than what they would charge if they viewed them as an independent market (Eisenmann et al., 2006). TradeLens is currently still in the process of growing the ecosystem, and is not extracting rents from either side. Although not supported by the collected data, the possibility that TradeLens will start extracting rents from either developers or supply chain participants as the ecosystem grows and the platform develops, cannot be discounted. This can give rise to another type of risk, related to renegotiation of terms. This hazard is similar to price renegotiation risk, described by Anderson et al. (2014, p.10): "*The risk that an alliance partner will take advantage of its position at a later date and seek unexpected price increases after entering into a contract*". While GTD/TradeLens encourages open and free participation on the marketplace in the early stages of ecosystem creation, terms renegotiation risk could arise if the supply chain actors get "locked-in" the platform (i.e. if TradeLens becomes an industry standard, and/or interoperability with other platforms is not ensured).

Focus on the end-to-end journey, opening up the possibility of creating new products and services and an open marketplace have been identified as TradeLens' main value propositions, separating it from competing platforms. An important question, which GTD Solution will need to address, along with other ecosystem members, is how value is captured and shared between them. The issue of claiming and allocating value is an important source of inter-firm conflict (Zajac and Olsen, 1993). Even though economic value may justify the push towards collaboration between participants, extracting value from the ecosystem might be difficult (Madhok and Tallman, 1998). Additionally, the value of TradeLens may be relatively "hidden" before TradeLens is widely adopted. The CEO and Partner at SeaIntelligence Consulting emphasized that: "*The system as a whole generates value, but that value is relatively invisible. That is very difficult to pass through* *in the shipping industry*". A number of interviewees noted that this presents a type of causality dilemma, because actors want to see immediate value in order to adopt the platform, but the value will only be realized once a sufficient number of participants joins the solution.

8. Governance

A governance structure of digital platforms should ensure that both platform owners and platform participants can realize their individual goals and interests. Effective governance can help align incentives, coordinate actions, mitigate disputes, incentivize knowledge sharing, and establish a common identity among platform participants (Grover and Kohli, 2012; Chen et al., 2020). Governance decisions and alignment of interests are of critical importance when deploying enterprise blockchains, because of high interdependence among network participants. Even though blockchains are physically distributed by design, a governance structure for making decisions on blockchain operations still needs to be in place (Jensen et al., 2019). If decision-making rights are not shared among ecosystem partners, it might be difficult to justify building an application which has to be shared with the partners in the ecosystem (Lacity, 2018).

Mærsk and IBM were the initiators of the TradeLens project, which is common when deploying industry-wide blockchain platforms (i.e. founder-led type), since the leading entity has a dominant market position that can be used to onboard downstream and upstream members of the value chain. When more members, especially competitors, join the platform, a new structure may evolve to a broader-based consortium (Rauchs et al., 2019). As the number of consortium members increases toward a critical mass, a combination of cooperative and competitive relationships between these companies starts to amass (Narayanan and Chen, 2012). Dominant firms in blockchain-based platforms thus need to purposely dissipate control, to convince other stakeholders they are working for the benefit of the entire ecosystem, and are not attempting to build their own competitive advantage at the expense of others (Lacity et al.,, 2019).

Aiming to position TradeLens as a neutral, open platform, which would eventually become a standard for the industry, Mærsk and IBM had to address the issues related to TradeLens' governance. Several definitions and categorizations of governance exist in literatures across various disciplines. In this paper governance is specifically associated with governance of blockchain-based platforms (e.g. Lacity et al., 2019). Based on the interview data, TradeLens' governance is discussed in terms of two distinct levels. The first level involves the decisions on ownership, participation, distribution of benefits and development of the platform. In other words, it encompasses agreements and arrangements between ecosystem members pertaining to overall goals and objectives of the platform. For the purpose of this paper, this level of governance is termed “Strategic governance”. The second level refers to technical execution of agreements between ecosystem participants. It determines who is in control of the data, and ensures that shared data are protected. This level is conceptualized as “Operational governance”. These definitions relate to Rauchs et al.’s (2019, p.14) notions of “social consensus”, and “network consensus” which they describe as: “*First, network participants and other stakeholders need to agree on the ruleset* […] *that governs the system as well as an adequate process for applying changes to the rules. Social consensus goes beyond mere governance of the system: it also involves the implicit agreement between stakeholders over the very nature (and, thus, associated characteristics) of the system*. […] *Once stakeholders have agreed on the nature of the system including its key properties, network participants need to establish agreement over the records produced by the system - i.e. the content itself. Network consensus refers to the process of resolving potential conflicts within the boundaries of the P2P network that may arise from multiple valid, but conflicting ledger entries*”.

8.1. Strategic governance

Data collected at Mærsk shows that the company took two material steps in terms of strategic governance, namely creating a separate business unit, called GTD Solution, and establishing an advisory board, comprised of TradeLens ecosystem members. GTD Solution operates at arm’s length from the rest of Mærsk, and treats Mærsk as any other shipping line. It ensures that whatever terms are offered to a particular network member in the ecosystem, regardless of who they are, those same terms would be made available to ocean carriers. The Head of Strategy and Operations at GTD Solution/TradeLens believes that this approach should alleviate some concerns of competing ocean carriers. He notes, “*When you interact with GTD, you're interacting with it as if it were its own company, even though it's part of the Maersk group. And so, you no longer have the risk of data that you're giving as a competitor to Maersk, to this platform, getting in the hands of Maersk itself because there is a separation of system, separations of people, separation of legal constructs*”.

The aim of establishing GTD Solution was to signal that TradeLens is a neutral platform, aiming to improve operational inefficiencies across the industry, rather than benefiting Mærsk alone. It should be noted, however, that GTD Solution is staffed by a combination of former employees of

Mærsk and IBM as well as external hires. As such, it is, at the time of this writing, unclear if establishing a separate business unit will be enough to convince potential adopters that Mærsk and IBM are sufficiently independent from the platform.

The second step was establishing the TradeLens advisory board, making sure that the decisions on the development of the platform, such as data standardization and the product roadmap, are transparent and aligned with other ecosystem members. The idea behind creating an advisory board was described by Digital product manager at Mærsk: "*The advisory board was a response to the many questions about: "Why should I join something that IBM has built for Maersk?" The idea was simply to listen to the industry, to set up a team of people who would be a representative of different actors in the supply chain, and to open that up. I think [that] on the one side it was a good move to have a voice of more than just one customer. At the same time, I think it illustrates one of the problems in shipping in general, that on the surface we all trust each other but actually we don't. That is what the advisory board was set down to do, to be the voice of the whole industry and to also have an influence on the development*".

Collected data suggests that the final shape of the advisory board is not yet determined. As the ecosystem grows, TradeLens will need to decide on the final configuration of the advisory board, and the level of decentralization of governance. This entails a tradeoff between the inclusion of a larger number of ecosystem participants and flexibility in terms of decision making. While overly centralized platform governance may result in too much power and influence residing with platform owners (Cheibub et al., 2010), overly decentralized platform governance structure may lead to slower goal setting, decision making and continued development (Chen et al., 2020). This tradeoff was also noted by the CEO and Partner at SeaIntelligence Consulting, "*If you invite a lot of carriers and give them veto right, you run into INTRRA problem – when you reach a minimum threshold, some of the carriers will be happy, and it's impossible to move it further. The other extreme would be to position it as Mærsk IBM project, get flexibility, but immediately alienate all the other carriers".*

8.2. Operational governance

In regards to operational governance, TradeLens had to address the issues of access to and control over shared data. The Head of Strategy and Operations at GTD Solution/TradeLens described these efforts: "*We took a number of steps to address concerns like, "What if I give my data to this* *platform that is controlled by my key competitor? What can they do with those insights, and what might they do with it?""*.

An important element contributing to data security on TradeLens is its underlying blockchain architecture. Because blockchains are tamper-evident, they enable firms on a network to identify potential opportunistic behavior more easily, which can in turn decrease the motivations of other relationship partners to engage in such behavior (Grafton and Mundy, 2017). Participants on a blockchain network, however, only benefit from the ability to independently verify transactions and the state of the system if they operate a full node themselves (Rauchs et al., 2019).

Respondents from Mærsk and IBM noted that even though the two companies initiated TradeLens, it quickly became clear that they cannot run all, or even majority, of the blockchain nodes, as this would result in excessive power in the hands of the two companies, going against the notion of truly neutral industry platform. They addressed this issue by offering participating ocean carriers an option to host and manage a blockchain node. Carriers who opt for this option are referred to as "trust anchors", and hold an exact copy of the ledger (Biazetti, 2020). Trust anchors are known to the network based on their cryptographic identities (TradeLens, 2018a), and participate in a consensus program, meaning they validate transactions, host data and assume a critical role of securing the network (Johnson, 2019; Lacity et al., 2019). As opposed to public permissionless blockchains, in which the ledger is replicated on every node in the system (i.e. universal data diffusion), only trust anchors hold a copy of the ledger on TradeLens' blockchain. This decision was made to increase speed and decrease costs of verification. The Digital product manager at Mærsk observed: "*Trust anchors are handling all the verification on behalf of the number of participants in the network. That speeds up everything, because you don't replicate the same truth on so many nodes […] The idea is that instead of having everyone setting up a node, you save the cost of doing that. Both in terms of transaction and also money of course. Because you don't need that server running, you don't need expertise in running that server and setting it up, and making sure everything is in place, security, privacy, GDPR and so on*". Ocean carriers who choose to be trust anchors, need to invest in relationship-specific assets (i.e. incur the investment and costs involved running a node).

In terms of data access, TradeLens uses a permissioning structure referred to as a "data sharing specification". It differentiates between three layers, called shipment, consignment and equipment. A shipment defines a commercial and financial relationship between buyer and a seller, and typically also includes the buyer’s and the seller’s banks. A consignment is the operational execution of that commercial relationship, and includes more organizations, such as ports and inland transportation providers, but will likely not involve the banks. Equipment is the unit that contains goods that are part of the commercial relationship (e.g. a shipping container). There is a many-to-many relationship between any of these three layers. A shipment for example, can be comprised of several different consignments, and a single consignment can have many shipments associated with it. For each of these layers, TradeLens identifies a role that a particular organization can play in the execution of a shipment, consignment or equipment. The identified role in turn determines what transactions a particular organization is able to access. Apart from the data sharing specification, TradeLens also leverages IBM blockchain “channel architecture”, which specifies how data is shared within the blockchain environment. A channel is established for each participating ocean carrier, and information is distributed only to those nodes participating in a channel (i.e. multi-channel diffusion). This means that none of the ocean carrier’s customer information will be distributed to other ocean carriers, which are not a part of a specific transaction. Actors are identifiable, and every transaction on a blockchain is signed with a digital certificate of a permissioned user (Biazetti, 2020). Moreover, only the hash value of commercially sensitive information is stored on the blockchain, so authorized participants are only able to see if the information has changed (through a changed hash value), without actually seeing the underlying data. Documents are stored on a single node only, and are accessed at runtime by other nodes on a particular channel as permissions allow (Jensen et al, 2019; Biazetti, 2020). This means that participants in the network stay in control of their own data, while TradeLens handles the operational integration of these independent actors using standard protocols.

It is important to note that while the permissioning structure and underlying blockchain architecture ensure that shared data is secure, and only available to authorized participants, they do not control for the accuracy and truthfulness of the data. As described by the Head of Strategy and Operations at GTD Solution/TradeLens: “*TradeLens doesn't validate data. It just ensures that whatever was put on the platform is as it was when it was put on. We deliberately don't make judgements as to what data are right*”. As such, TradeLens cannot fully mitigate data quality risk, as this would require a gateway and additional protocols (Szabo, 2017; Kostić and Sedej, 2020).

9. Interoperability

Interoperability is a critical capability that allows interaction between heterogeneous information systems. In case of TradeLens, the notion of interoperability is particularly related to the concepts of efficiency and risk. First, in the event that TradeLens would not be made interoperable with existing systems of potential participants, they would need to run two systems in parallel. In other words, companies would need to run "just another piece of software", in addition to running the existing systems. This would result in increased workload, and harm the efficiencies TradeLens aims to provide. Second, if TradeLens is not made interoperable with other blockchain-based shipping platforms, potential joiners would face the risk of investing time and money in a platform that might not become an industry standard in the future.

Because of these concerns, interoperability is here discussed in terms of two distinct levels. First, the interoperability between TradeLens and legacy systems of ecosystem members, and second, the interoperability between TradeLens and other shipping platforms. According to the collected data, making TradeLens easily interoperable with legacy systems could improve perceived usability of the platform and help attract large customers. Several respondents noted that on-boarding large clients would speed up the adoption process considerably, because large customers use different ocean carriers. This reasoning was confirmed by Digital product manager at Mærsk, when asked about plans for TradeLens' diffusion. He observed: "*The idea was to find the strong partners that could create critical mass, and then have them influence their networks to grow the [TradeLens] network*". Convincing a large customer base to start using TradeLens would therefore provide an incentive for other ecosystem actors, especially ocean carriers, to adopt the platform. Large customers, in turn, require seamless interoperability between TradeLens and their legacy systems, in order to improve their operational efficiencies. As noted by a Project Lead at Global International team at Anheuser-Busch InBev: "*Imagine that you're shipping over 250,000 containers a year. We need to have a platform directly interfacing with our system. Because the operational teams cannot go and manually put all the data needed for ocean booking or shipping instructions. That would require an army of people and we definitely don't want this. We must have something connected*".

Integrating TradeLens with legacy systems however, requires a certain level of relationship-specific investment (e.g. data mapping, testing). This introduces a risk for potential joiners, as these investments might be forfeit if the TradeLens does not "catch on" and majority of their transacting partners decide to adopt a different platform. Hill (1995, p.120) observes that "*[…] the more specialized a resource becomes, the lower its value in alternative uses […] The contingent value of a specialized resource exposes its owner to a greater risk of "hold-up" than the owner of a generalized resource*". To address these concerns, the second level of interoperability is discussed. If TradeLens will be made interoperable with other blockchain-based shipping platforms, the risk of forfeiting relationship-specific investments is reduced for potential adopters, which could in turn increase the likelihood of them adopting the platform.

9.1. Interoperability between TradeLens and legacy systems

A crucial step TradeLens took to support integration with participants' legacy systems, and ensure simpler interoperability within the industry, was to make its Application Programming Interfaces (APIs) freely available.

As noted by respondents from Mærsk and GTD solution, there are two different options for connecting to TradeLens. Ecosystem members can interact with the platform by either linking it to their proprietary IT systems via APIs or through a user interface. Linking the proprietary systems with TradeLens is particularly interesting for big organizations that are processing large amounts of data. As the Head of Strategy and Operations at GTD Solution/TradeLens observed: "*[…] if you think of a shipping line or a terminal, the amount of data that they are using is considerable, and those data need to be in our platform at scale. And that's not going to happen if you have to have 40 people in a room typing data into a system that can then go to TradeLens".* Organizations may also opt for the option of using a user interface, instead of integrating their existing systems with the platform. This is particularly relevant for smaller firms, who either do not have a core system with which to integrate, or consider such an integration too expensive. GTD Solution and IBM also offer on-boarding support for companies that decide to join. The On-boarding team provides guidance and assistance with data and process mapping as well as integration testing, to ensure firms' current operational systems are able to both feed, as well as consume data from TradeLens. Additionally, TradeLens started to collaborate with third-party integration providers, who may also offer on-boarding support to prospective clients. This may be a particularly interesting option for companies who are hesitant to let on-boarding teams from GTD Solution or IBM too close to their proprietary data.

The support offered by GTD Solution and IBM, as well as open APIs reflect the ambition of the two companies to make connecting to TradeLens as easy as possible, and further motivate industry actors to adopt the platform. Some interviewees, however, suggest that integration with legacy systems is not a trivial issue. They argue that it is difficult to assess the maturity of the proprietary IT systems, and that the integration will require organizations to change their internal processes and "tech set-up" in order to accommodate working with the APIs from TradeLens. This can be particularly difficult for companies using a lot of customized software, accumulated over the years. The Digital product manager at Mærsk argued that: "*Over time you build a lot of technical depth, and just by introducing new modern APIs, that's never going to solve the legacy problems, or the technical depth that you may have built up over 20 years. In supply chain, a lot of the software is bespoke software. And a lot of it, with large players as well, is something that they've built in-house so we're not talking about standard software*". Some respondents also noted that simply introducing new technology will not resolve persistent data quality issues. As observed by the CTO of Youredi, TradeLens' integration solutions provider: "*When updating an existing integration from old batch-based to a modern API […] many players will give you the impression that using new technology will somehow magically fix problems with the old technology, and this is very often not the case. Implementing a new API might give a company the opportunity to fix issues with old technology, but new technology is no guarantee that issues will be fixed. Fixing data quality errors usually requires improvements to several downstream systems in the process*".

9.2. Interoperability between TradeLens and other blockchain platforms

Interoperability between TradeLens and other blockchain-based shipping platforms is a critical consideration for potential joiners, as it decreases switching costs and the risks related to asset specificity. A report by World Economic Forum (2020) suggests that companies do not want to get locked in to a specific blockchain platform, as this could inhibit their possibilities for external collaboration in the future.

Considering this level of interoperability is important for TradeLens, since respondents seem to be in agreement that more than one blockchain-based platform is likely to exist in the future. The CDIO of MSC for example suggests that, "*The world needs more than one platform, that's for sure. There has to be interoperability because you will always have some of the parties using platform A and some of the parties using platform D or E or F, because that's going to develop*". This sentiment was recently also confirmed by Michael White, CEO of GTD Solution, who acknowledged that TradeLens will need to be interoperable with other platforms, such as GSBN (Johnson, 2020).

An important development in terms of interoperability between TradeLens and other shipping platforms was announced in March 2020, when developers from Oracle, IBM and SAP disclosed they had completed cross-network testing, and were able to connect consortia of firms, clustered on different platforms (Allison, 2020). Since TradeLens is run on an IBM blockchain (based on Hyperledger Fabric), and GSBN is run on Oracle blockchain, this could mean that the risk for partners to join either of the platforms will be diminished considerably, as transaction-specific costs and switching costs are significantly reduced.

10. Discussion

While TradeLens promises to reduce transaction costs and increase the overall efficiency of information exchange once industry-wide adoption has taken place, these benefits should be compared to the risks of establishing and maintaining collaboration. Table 2 outlines specific hazards facing potential TradeLens adopters and corresponding control mechanisms. While the first two risks are related to TradeLens' performance, and could be more broadly classified as performance risks, the other five risks are more closely related to relational risk (Das and Teng, 1996).

Risk	Description	Dimension	Mechanism
Insufficient value proposition	The risk that TradeLens will not live up to its expected potential (i.e. The functionalities will not be valued by participants; It will not be able to onboard sufficient number of customs authorities, or a competing platform will be able to onboard more; Applications on the marketplace will not be valued by participants, or a competing platform will offer better applications)	Value creation Governance Interoperability	• Network effects • Opening the marketplace • Interoperability with other platforms
Lack of interoperability	The risk that seamless interoperability between TradeLens and legacy systems is not ensured. In this case, companies would need to run TradeLens in parallel with existing systems inparallel, thus considerably increasing the workload, and harming the efficiencies that TradeLens aims to provide	Interoperability	• Open APIs • Onboarding team • Change management
Unfair use of power	Risks that could arise because of concentrated ownership (i.e. Mærsk and IBM owning TradeLens' IP rights). Because the two companies own the forum for communication, they could restrict access to certain participants, favour particular parties over other, or otherwise use their power to disatvantage certain actors, notably competing shipping lines	Governance Interoperability	• Shadow of the future/Reputational damage • Advisory board • Interoperability with other platforms
Loss or misuse of proprietary data	The risk that firms' proprietary data would be exposed to other participants in the network, who could use it in a manner that could negatively affect the firm. This risk also involves the use of aggregated data, which platform owners could monetize without explicit permission of data owners.	Governance	• Blockchain (Design decisions) • Permissioning structure • Shadow of the future/Reputational damage
Renegotiation of terms on the marketplace due to lock in	The risk that platform owners will start extracting rents from either side of the two-sided market if TradeLens becomes an industry standard, and partners become locked into the platform, because of their transaction-specific investments	Value creation Interoperability	• Making apps available on other platforms • Interoperability with other platforms • Negative two-sided network effects
Compliance and regulatory risk	The risk of exposing parties to sanctions of external parties (Anderson et al., 2014), because an external agent is taking care of compliance process	Value creation Governance	• Auditing compliance related protocols
Verification of data quality	The risk that the firm will be unable to verify or evaluate the quality of shared data in a timely manner	Governance	• Blockchain (post-contractual control) • Gateway

Table 2: Transaction hazards for potential TradeLens adopters and corresponding control mechanisms

Insufficient value proposition is a risk that TradeLens' functionalities or applications on the marketplace will not be valuable for potential adopters or that TradeLens will not be able to onboard sufficient number of customs authorities, which are often seen as a major source of inefficiencies in global supply chains. While TradeLens developed the initial applications, it also opened its marketplace to third-party developers. In doing so, it allowed for possibility of creating two-sided positive network effects. Since users typically value platforms with wide variety of apps, and developers value platforms with more users, opening the marketplace can create an incentive for both sides of the market to transact on the platform (Eisenmann et al., 2016). TradeLens will likely need to consider the level of marketplace openness as its ecosystem grows, and the platform develops. Selecting the optimal degree of openness is crucial for platform owners (Parker and Van Alstyne, 2018), often involving a trade-off between ecosystem growth, and the possibility for value appropriation (West, 2003). While opening a platform can propel its growth, it also reduces switching costs, and decreases the platform's owner ability to capture rents (Parker and Van Alstyne, 2018). Convincing customs authorities to join either of the platforms will likely continue to be a challenge, due to conservatism of these actors and political considerations involved. For customs authorities that are considering adopting a supply chain platform, however, TradeLens, a platform that gathered the largest number of ecosystem members, might present a more desirable option than alternatives. Due to two-sided network effects customs authorities would benefit the most from adopting a platform with largest number of users. At the same time, TradeLens could benefit from subsidizing customs authorities (by covering the costs of integration for instance), since onboarding more of them could incentivize additional supply chain actors to join its ecosystem. Platform owners often make investments to attract actors from one side of the market (i.e. subsidy-side), knowing that the other side (i.e. money-side) will follow once the number of subsidy-side participants is large enough (Parker et al., 2016).

The second performance risk is related to lack of interoperability between TradeLens and legacy systems. TradeLens made considerable progress in regards to ensuring interconnectivity with legacy systems by providing open APIs, creating an onboarding team and enlisting help from integration providers. The pertinent issue, however, is highly customized software, which numerous actors across global supply chains accumulated over the years. While the onboarding team and integration providers may offer help with the integration, future adopters will likely need to make additional investments in change management efforts (e.g. data mapping, testing, end user training, business process reengineering) to be able to fully leverage TradeLens' efficiencies.

Although collected data indicates that interoperability between TradeLens and legacy systems is not an insurmountable obstacle, it will likely take some time, before seamless interoperability is achieved.

The risk of unfair use of power is a critical relational risk, particularly for Mærsk's competitors. As Allison (2018) notes: "*It's hard enough to get enterprises that compete with each other to work together as a team, but it's especially tricky when one of those rivals owns the team*". Because Mærsk and IBM are the sole owners of TradeLens, they could use their power to restrict or limit access to information to specific participants or engage in activities that would otherwise disadvantage them. While this can pose a serious threat, there are some mechanisms in place that might help alleviate this hazard. First, TradeLens' value is contingent on data, provided by a number of actors along the supply chain. If Mærsk and IBM engage in activities that would disadvantage certain participants, harmed parties could stop feeding data into the platform, thus breaking the chain of full visibility of container journey. Because GTD Solution intends to monetize its applications on the marketplace, the value of which is contingent on data that flows into the platform, it is in the company's self-interest to get as much data from as many participants as possible. Additionally, engaging in unfair competition may result in reputational damage for Mærsk and IBM, which could limit their possibilities for future collaboration with both the harmed parties, as well as other parties in a network as a result of trust transference effect (Reusen and Stourhuysen 2020). These considerations are in line with Axelrod and Keohane's (1985) notion of "Shadow of the future", where companies compare present gains of opportunistic behavior with the cost of potential future benefits resulting from such behavior (Telser, 1980). The advisory board serves as another control mechanism. Although without decision-making power, it provides transparency of decision making, and would allow involved actors to detect potential threats earlier, and act on them. Finally, the threat of Mærsk and IBM using their power unfairly is greatly diminished if TradeLens is made interoperable with competing platforms offering similar services. Even though these mechanisms provide some level of assurance, they do not eliminate this hazard. If TradeLens becomes an industry standard, and creates significant network effects, it may drive out weaker rivals. When two-sided network effects are positive and strong, users typically converge on one platform (Eisenmann et al., 2006).

The risk of loss or misuse of proprietary data, or intellectual property risk, relates to the possibility that transaction partners will use proprietary data in way that could negatively affect the firm that provided the data (Clemons and Hitt, 2004; Anderson et al., 2014). This is a particularly salient concern because of high competitiveness and low trust that characterize the shipping industry. The permissioning structure and underlying blockchain technology are critical control mechanisms related to this hazard. It is often assumed that blockchain will provide security, transparency and trustworthy data to the companies that implement it. These characteristics, however, will depend on decisions made during the design of a particular blockchain system. In terms of intellectual property risk, the design decisions made on the network layer, namely network access, transaction processing and broadcast, are particularly critical. The access to TradeLens' network is closed, meaning that a gatekeeper (i.e. GTD Solution) has to authorize access. Closed network access is typically preferable for enterprise blockchains, due to high trust requirements, since more open systems are generally more exposed to malevolent actors (Rauchs et al., 2019). TradeLens employs permissioned transaction processing, where only pre-approved participants (i.e. Trust Anchors) are able to verify transactions. By offering participating carriers to host a blockchain node and validate transactions, TradeLens made significant strides in terms of addressing this risk. In the event that transaction processing would be limited to only Mærsk and IBM, the two companies could rewrite any portion of the blockchain as needed (Coyne and McMickle, 2017). Several major ocean carriers have agreed to act as Trust Anchors so far, including MSC, CMA CGM, and Ocean Network Express (TradeLens, 2019b; TradeLens, 2019c). Dyer (1997) observes that trustworthiness often results in higher levels of investments in specialized assets, since the benefits of these investments will more likely outweigh the costs of safeguarding them. This is indeed the case for TradeLens as well, as ocean carriers that consider running a full node, must trust the system as a whole in order to make the investment. Interestingly, the inverse is also true in case of TradeLens, as Trust Anchors need to make an investment in a specialized asset (i.e. running a full node), in order to participate in the consensus process and ensure trustworthiness of the system. In terms of data broadcast, TradeLens utilizes multi-channel diffusion rather than universal data diffusion. While the latter would result in perfect transparency, and make the system more resilient, it is unlikely that enterprises would be willing to accept universal diffusion of proprietary data. TradeLens thus implemented a more closed and centralized system (as compared to public blockchain networks), which is typical for enterprise blockchain, due to privacy and confidentiality requirements. It does, however, require relaxing some assumptions regarding full transparency, security and immutability that (public) blockchains strive for (Platt, 2017b). Similar to the discussion above, the "shadow of the future" is a relevant control mechanism related to this risk. The underlying blockchain data structure provides an additional safeguard, since records on a tamper-evident ledger would allow for regular monitoring, thus increasing the probability of opportunistic behavior being identified and sanctioned. In that sense, TradeLens' underlying blockchain structure can also lead participants who share the data, to rely more on calculative trust as opposed to only relying on relational trust (Kostić and Sedej, 2020).

The risk of renegotiation of terms on the marketplace could arise if TradeLens becomes an industry standard, locking the participants in the platform. Moreover, if developers create applications which are only compatible with TradeLens' marketplace, GTD Solution could start extracting rents from both developers, and ecosystem members. Investments in transaction specific assets (i.e. apps developed solely for TradeLens) can shift the power balance between parties in later negotiations, because the costs of development are sunk for the party that incurred them (Anderson et al., 2000). Interoperability between TradeLens and other blockchain platforms and making apps compatible with similar platforms (much like many applications are available on both Apple's iOS and Google's Android) can provide some level of assurance for both developers and ecosystem members. If, however, TradeLens becomes an industry standard, forcing out weaker rivals, both sides of the market could get locked in to the platform, making it easier for GTD Solution to start collecting revenue from either side. Such extraction of rents is not problematic in and of itself, as platform owners typically collect revenue from platform participants (Parker et al., 2016). The risk, however, is that GTD Solution would start extracting rents, deemed unfair by involved participants. The collected data does not allow for the identification of a particular control mechanism that could alleviate these concerns. Nonetheless, developers of applications should still have some leverage in negotiating a "fair" rent, by threatening to remove their products and services from the marketplace, thereby creating negative two-sided network effects (Eisenmann et al., 2006; Parker et al., 2016). Because in two-sided markets, the value for participants on one side is contingent on the number of participants on the other side (de Reuver et al., 2018), a number of developers abandoning the marketplace would make the platform less valuable for supply chain actors, and limit GTD Solution's ability to capture rents.

Compliance and regulatory risk refers to the risk of exposing TradeLens' participants to sanctions of external parties (Anderson et al., 2014). As firms exchange data through platform using TradeLens' standard formats and protocols, a part of their compliance process becomes dependent on the platform's operators. This is especially critical because TradeLens aims to become a global tool, spanning many national borders and jurisdictions. When this type of risk is high, companies entrusting their compliance process to TradeLens, might be particularly focused on reviewing the compliance related protocols employed by the system. This, however, mandates that these protocols are made transparent and available for audit when requested by the affected parties.

Verification of data quality risk refers to firm's inability to verify that the data, received from its partners is trustworthy and accurate. This risk is not inherent to TradeLens, as firms already need to verify the data received from their transaction partners irrespective of the channel used to exchange information. The risk, however, could arise if firms assume that TradeLens' underlying blockchain will, by itself, remedy data quality issues. This does not hold true for data exogenous to the blockchain system. While blockchain may assure that the uploaded data has not been tampered with (provided that suitable design decisions were made), it does not ensure that the uploaded data is correct. Recording data on a tamper-evident ledger, however, can still reduce the costs of post-contractual control (Schmidt and Wagner, 2019), as it allows firms to audit the records, and more easily identify the source of low quality (and potentially fraudulent) data, and act on this information. Addressing data quality issues would require establishing a "gateway", controlling the data entry, as well as introducing additional rules and protocols, including more traditional management controls (Szabo, 2017; Kostić and Sedej, 2020).

11. Conclusion

Due to the multi-party nature of blockchain systems (Glaser, 2017), building collaboration between various industry actors is a critical prerequisite for the successful deployment of enterprise blockchain networks (e.g. Mattke et al., 2019; Zavolokina et al., 2019). At the same time, it is also one of the biggest challenges inherent to blockchain initiatives, as companies are reluctant to contribute to a common information infrastructure, which often needs to be shared with rivals. While competitors must collaborate to generate common value for the network, there is tension between the goals of the collaboration and the goals of each partner (Tidström, 2014).

The purpose of this paper was to determine the most critical elements contributing to the development of inter-firm collaboration on an industry-wide blockchain network. It attempted to do so by following the development of TradeLens, a supply chain platform, underpinned by blockchain technology, jointly developed by Mærsk and IBM. Building on an in-depth analysis of rich qualitative data collected at Mærsk, IBM, GTD Solution, and various other participants of the shipping ecosystem, it identified three key elements, which were found to be essential in shaping the decision of industry participants to engage in collaboration on a blockchain network.

The first of the three identified elements, value creation, relates to the benefits, firms could accrue from joining a blockchain network. The second element, governance, pertains to safeguards, employed to protect participants from potential opportunistic behavior by other parties on the network. While it is often assumed that companies can make their transactions secure, simply by introducing blockchain in their operations, this paper has tried to dispel some common misconceptions about the technology. It emphasized the role of different decisions, which need to be made during the system's design, and how they, in turn, influence the system's characteristics. The purpose of the governance dimension is also to assure potential adopters that value created on a blockchain network will be distributed fairly among all participants, and will not disproportionally benefit the blockchain system's founder. The potential for unequal distribution of co-created value between partners, who are also rivals, has been identified as a considerable relational risk since the partners share the same competitive goals on the market (Grafton and Mundy, 2017). Finally, the interoperability element can contribute to increasing perceived usability of the system, and reducing the risks related to asset specificity.

This study is subject to several limitations. The case study method potentially is subject to researcher-induced bias both during data collection and analysis. Although case-based research and qualitative data can facilitate investigation of complex phenomena, they also restrict statistical generalizability of findings (Yin, 2009; Grafton and Mundy, 2017). This study does not suggest that the three identified elements fully explain all aspects of shipping industry actors' decision-making process, and that achieving satisfactory results in each of these areas will unequivocally result in successful deployment of a blockchain network. The latter will likely depend on several contingencies of each specific implementation project, such as individual preferences of a particular ecosystem actor, their prior relation with transaction partners, and specifics of local regulation. Another important element not discussed in this paper is the agreement on common data standards across the industry. Not only are common standards central for enabling collaboration on the platform, they are also critical for ensuring interoperability.

Despite limited generalizability, observations from this study could provide insights for firms from other industries, developing or interested in exploring blockchain-based platforms. The founders should carefully consider proposed design decisions when building a blockchain system, as these decisions will determine the system's characteristics and influence the collaboration decisions of other actors in the industry. Moreover, building an industry-wide solution will likely involve actors with heterogeneous interests, which can inhibit collaboration and threaten the success of standard development (Markus et al., 2006). Demonstrating the proposed value and building an appropriate governance structure could help align interests of various stakeholders and aid diffusion of industry-wide blockchain solution, irrespective of a particular industry. In addition, establishing a body, such as TradeLens' advisory board, can ensure the collective participation of representative members of heterogeneous user groups, further increasing the likelihood of market adoption. Finally, ensuring interoperability of industry-wide platform with legacy systems, as well as with other (potentially competing) industry-wide platforms can lead to increased efficiency and lower risk, which can incentivize a greater number of industry participants to join a particular blockchain network. Future studies could continue to explore the TradeLens case as it develops, and evaluate the progress made in each of the three dimensions. Researchers could also explore TradeLens case in various detail (e.g. the financial impact of TradeLens on operations of a particular company, impact of digitized trade documentation and automatic execution of pre-defined rules on management control). The three identified dimensions could also be applied to explore the dynamics of building collaboration on blockchain-based platforms in other industries.

The landscape of industry-wide blockchain-based platforms continues to evolve, and will likely change the way in which companies collaborate and share data with one another. Proliferation of such platforms will open several possible avenues for research across various disciplines, such as management accounting, strategy, economics and operations management.

References:

Allison, I. (2018). IBM and Maersk Struggle to Sign Partners to Shipping Blockchain. *Available at:* https://www.coindesk.com/ibm-blockchain-maersk-shipping-struggling

Allison, I. (2020). Rival IT giants IBM and Oracle are working to make their blockchains communicate with each other. *Available at:* https://www.coindesk.com/old-rivals-oracle-and-ibm-want-their-blockchains-to-talk-to-each-other

Anderson, S. W., & Dekker, H. C. (2005). Management control for market transactions: The relation between transaction characteristics, incomplete contract design, and subsequent performance. *Management science, 51*(12), 1734-1752.

Anderson, S. W., Glenn, D., & Sedatole, K. L. (2000). Sourcing parts of complex products: evidence on transactions costs, high-powered incentives and ex-post opportunism. *Accounting, Organizations and Society, 25*(8), 723-749.

Anderson, S. W., Christ, M. H., Dekker, H. C., & Sedatole, K. L. (2014). The use of management controls to mitigate risk in strategic alliances: Field and survey evidence. *Journal of Management Accounting Research, 26*(1), 1-32.

Anderson, S. W., Christ, M. H., Dekker, H. C., & Sedatole, K. L. (2015). Do extant management control frameworks fit the alliance setting? A descriptive analysis. *Industrial Marketing Management, 46,* 36-53.

Axelrod, R., & Keohane, R. O. (2018). Achieving cooperation under anarchy: Strategies and institutions. In *Cooperation under anarchy* (pp. 226-260). Princeton University Press.

Baiman, S., & Rajan, M. V. (2002). The role of information and opportunism in the choice of buyer-supplier relationships. *Journal of Accounting Research, 40*(2), 247-278.

Beck, R., Stenum Czepluch, J., Lollike, N., & Malone, S. (2016). Blockchain–the gateway to trust-free cryptographic transactions.

Beck, R., & Müller-Bloch, C. (2017, January). Blockchain as radical innovation: a framework for engaging with distributed ledgers as incumbent organization. In *Proceedings of the 50th Hawaii International Conference on System Sciences*.

Biazetti , A. (2020). Automating global logistics starts with digital documents. *Available at*: https://www.tradelens.com/post/automating-global-logistics-starts-with-digital-documents?

Browning, L. D., Beyer, J. M., & Shetler, J. C. (1995). Building cooperation in a competitive industry: SEMATECH and the semiconductor industry. *Academy of Management Journal, 38*(1), 113-151.

Castañer, X., & Oliveira, N. (2020). Collaboration, coordination, and cooperation among organizations: Establishing the distinctive meanings of these terms through a systematic literature review. *Journal of Management, 46*(6), 965-1001.

Catalini, C., & Gans, J. S. (2016). *Some simple economics of the blockchain* (No. w22952). National Bureau of Economic Research.

Cheibub, J. A., Gandhi, J., & Vreeland, J. R. (2010). Democracy and dictatorship revisited. *Public choice, 143*(1), 67-101.

Chen, Y., Pereira, I., & Patel, P. C. (2020). Decentralized governance of digital platforms. *Journal of Management*, 0149206320916755.

Christ, M. H., & Nicolaou, A. I. (2016). Integrated information systems, alliance formation, and the risk of information exchange between partners. *Journal of Management Accounting Research*, *28*(3), 1-18.

Clement, A., & Wagner, I. (1995). Fragmented exchange: Disarticulation and the need for regionalized communication spaces. *In Proceedings of the Fourth European Conference on Computer-Supported Cooperative Work ECSCW'95* (pp. 33-49). Springer, Dordrecht.

Clemons, E. K., & Hitt, L. (2004, January). Poaching and the misappropriation of information: an increasingly important form of opportunism. In *Proceedings of the 37th Hawaii International Conference on Systems Science, Kona, HI, IEEE Comp. Soc. Press, Los Alamitos, CA*.

Clemons, E. K., & Row, M. C. (1992). Information technology and industrial cooperation: the changing economics of coordination and ownership. *Journal of Management Information Systems, 9*(2), 9-28.

Collis, J., & Hussey, R. (2013). Business research: *A practical guide for undergraduate and postgraduate students*. Macmillan International Higher Education.

Coyne, J. G., & McMickle, P. L. (2017). Can blockchains serve an accounting purpose?. *Journal of Emerging Technologies in Accounting, 14*(2), 101-111.

Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2016). Blockchain technology: Beyond bitcoin. *Applied Innovation, 2*(6-10), 71.

Das, T. K., & Teng, B. S. (1996). Risk types and inter-firm alliance structures. *Journal of management studies, 33*(6), 827-843.

Dattée, B., Alexy, O., & Autio, E. (2018). Maneuvering in poor visibility: How firms play the ecosystem game when uncertainty is high. *Academy of Management Journal, 61*(2), 466-498.

de Reuver, M., Sørensen, C., & Basole, R. C. (2018). The digital platform: a research agenda. *Journal of Information Technology, 33*(2), 124-135.

Dekker, H. C. (2004). Control of inter-organizational relationships: evidence on appropriation concerns and coordination requirements. *Accounting, organizations and society, 29*(1), 27-49.

Doz, Y.L. (1996). The evolution of cooperation in strategic alliances: Initial conditions or learning processes? *Strategic Management Journal*, (17), 55–83.

Doz, Y., Hamel, G., & Prahalad, C. K. (1989). Collaborate with your competitors and win. *Harvard business review, 67*(1), 133-139.

Dubois, A., & Gadde, L. E. (2002). Systematic combining: an abductive approach to case research. *Journal of business research, 55*(7), 553-560.

Dyer, J. H. (1996). Does governance matter? Keiretsu alliances and asset specificity as sources of Japanese competitive advantage. *Organization science, 7*(6), 649-666.

Dyer, J. H. (1997). Effective interim collaboration: how firms minimize transaction costs and maximise transaction value. *Strategic management journal, 18*(7), 535-556.

Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of management review, 23*(4), 660-679.

Edmondson, A. C., & McManus, S. E. (2007). Methodological fit in management field research. *Academy of management review, 32*(4), 1246-1264.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, *14*(4), 532-550.

Eisenmann, T., Parker, G., & Van Alstyne, M. W. (2006). Strategies for two-sided markets. *Harvard business review*, *84*(10), 92.

ESCAP (United Nations Economic and Social Commission for Asia and the Pacific) (2014). *ESCAP ANNUAL REPORT 2014. Available at:* https://www.unescap.org/sites/default/files/ESCAP-Annual-Report-2014.pdf

Foray, D. (1994). Users, standards and the economics of coalitions and committees. *Information economics and policy*, *6*(3-4), 269-293.

Glaser, F. (2017, January). Pervasive decentralisation of digital infrastructures: a framework for blockchain enabled system and use case analysis. *In Proceedings of the 50th Hawaii international conference on system sciences*. Available at: https://pdfs.semanticscholar.org/859d/0535e16095f274df4d69df54954b21258a13.pdf

Glaser, B. G., & Strauss, A. L. (2017). *Discovery of grounded theory: Strategies for qualitative research*. Routledge.

Grafton, J., & Mundy, J. (2017). Relational contracting and the myth of trust: Control in a co-opetitive setting. *Management Accounting Research*, *36*, 24-42.

Grover, V., & Kohli, R. (2012). Cocreating IT value: New capabilities and metrics for multifirm environments. *Mis Quarterly*, 225-232.

Gulati, R., Wohlgezogen, F., & Zhelyazkov, P. (2012). The two facets of collaboration: Cooperation and coordination in strategic alliances. *Academy of Management Annals*, *6*(1), 531-583.

Guven Kocak, S. (2015). Maritime informatics framework and literature survey-ecosystem perspective. In *AMCIS 2015 Proceedings*. Puerto Rico, USA.

Hill, C. W. (1995). National institutional structures, transaction cost economizing and competitive advantage: The case of Japan. *Organization Science*, *6*(1), 119-131.

Iansiti, M. & Lakhani, K.R. (2017). The Truth About Blockchain. *Harvard Business Review*. Available at: https://hbr.org/2017/01/the-truth-about-blockchain

ICAEW (2017). Blockchain and the future of accountancy. *Available at:* https://www.icaew.com/en/technical/information-technology/technology/blockchain/blockchain-and-the-accounting-perspective

International Data Corporation (2019). New IDC Spending Guide Sees Strong Growth in Blockchain Solutions Leading to $15.9 Billion Market in 2023. *Available at:* https://www.idc.com/getdoc.jsp?containerId=prUS45429719

Jensen, T., Hedman, J., & Henningsson, S. (2019). How TradeLens Delivers Business Value With Blockchain Technology. *MIS Quarterly Executive*, *18*(4).

Jensen, T., & Vatrapu, R. (2015). Ships & roses: a revelatory case study of affordances in international trade.

Jensen, T., Vatrapu, R., & Bjørn-Andersen, N. (2018). Avocados crossing borders: The problem of runaway objects and the solution of a shipping information pipeline for improving international trade. *Information Systems Journal*, *28*(2), 408-438.

Johnson, E. (2019). TradeLens boosts arsenal with addition of Hapag-Lloyd, ONE. *Available at:* https://www.joc.com/technology/tradelens-boosts-arsenal-addition-hapag-lloyd-one_20190702.html

Johnson, E. (2020). DP World addition bolsters TradeLens appeal. *Available at:* https://www.joc.com/technology/blockchain-supply-chain/dp-world-addition-bolsters-tradelens-appeal_20200528.html

Klein, B., Crawford, R. G., & Alchian, A. A. (1978). Vertical integration, appropriable rents, and the competitive contracting process. *The journal of Law and Economics*, *21*(2), 297-326.

Korpela, K., Hallikas, J., & Dahlberg, T. (2017, January). Digital supply chain transformation toward blockchain integration. In *proceedings of the 50th Hawaii international conference on system sciences*.

Kostić, N. & Sedej, T. (2020). Blockchain technology, inter-organizational relationships and management accounting: A synthesis and research agenda. (May 16, 2020). Working paper, *Copenhagen Business School*.

Kvale, S. (1996). *Interviews. An Introduction to Qualitative Research Interviewing*. London. SAGE.

Lacity, M. C. (2018). Addressing key challenges to making enterprise blockchain applications a reality. *MIS Quarterly Executive*, *17*(3), 201-222.

Lacity, M.C., Steelman Z., & Cronan, P. (2019). Blockchain Governance Models: Insights for Enterprises [White paper]. *Available at*: https://cpb-us-e1.wpmucdn.com/wordpressua.uark.edu/dist/5/444/files/2019/11/BCCoEWhitePaper022019OPEN.pdf

Ledger Insights (2020). COSCO, CMA CGM to become shareholders in GSBN blockchain shipping consortium. *Available at*: https://www.ledgerinsights.com/blockchain-shipping-consortium-cosco-cma-cgm-hapag-lloyd-gsbn/

Lind, M., Michaelides, M., Ward, R., & Watson, R. T. (2020). *Maritime Informatics*. Springer.

Liu, H. (2020). Blockchain and Bills of Lading: Legal Issues in Perspective. In *Maritime Law in Motion* (pp. 413-435). Springer, Cham.

Lumineau, F., Wang, W., & Schilke, O. (2020). Blockchain Governance—A New Way of Organizing Collaborations?. *Organization Science.*

Luo, Y. (2006). Opportunism in Inter-firm Exchanges in Emerging Markets [1]. *Management and Organization Review, 2*(1), 121-147.

Madhok, A., & Tallman, S. B. (1998). Resources, transactions and rents: Managing value through interfirm collaborative relationships. *Organization science, 9*(3), 326-339.

Malhotra, D., & Lumineau, F. (2011). Trust and collaboration in the aftermath of conflict: The effects of contract structure. *Academy of management Journal, 54*(5), 981-998.

Markus, M. L., Steinfield, C. W., & Wigand, R. T. (2006). Industry-wide information systems standardization as collective action: the case of the US residential mortgage industry. *MIS quarterly,* 439-465.

Mattke, J., Hund, A., Maier, C., & Weitzel, T. (2019). How an Enterprise Blockchain Application in the US Pharmaceuticals Supply Chain is Saving Lives. *MIS Quarterly Executive, 18*(4).

McCracken, G. (1988). *The long interview* (Vol. 13): SAGE publications, Inc.

Miles, M.B. and Huberman, A.M. (1994). *Qualitative Data Analysis* (2nd ed.). London: Sage.

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. *Available at*: https://bitcoin.org/bitcoin.pdf

Narayanan, V. K., & Chen, T. (2012). Research on technology standards: Accomplishment and challenges. *Research Policy, 41*(8), 1375-1406.

Nofer, M., Gomber, P., Hinz, O., & Schiereck, D. (2017). Blockchain. *Business & Information Systems Engineering, 59*(3), 183-187.

Nærland, K., Müller-Bloch, C., Beck, R., & Palmund, S. (2017, December). Blockchain to Rule the Waves-Nascent Design Principles for Reducing Risk and Uncertainty in Decentralized Environments. In *ICIS.*

O'Leary, D. E. (2017). Configuring blockchain architectures for transaction information in blockchain consortiums: The case of accounting and supply chain systems. Intelligent Systems in Accounting, Finance and Management, 24(4), 138-147.

Ouchi, W. G. (1980). Markets, bureaucracies, and clans. *Administrative science quarterly*, 129-141.

Oxley, J.E., (1997). Appropriability hazards and governance in strategic alliances: A transaction cost approach. *The Journal of Law, Economics, and Organization, 13*(2), pp.387-409.

Parker, G. G., & Van Alstyne, M. W. (2005). Two-sided network effects: A theory of information product design. *Management science, 51*(10), 1494-1504.

Parker, G. and Van Alstyne, M., (2018). Innovation, openness, and platform control. *Management Science, 64*(7), pp.3015-3032.

Parker, G. G., Van Alstyne, M. W., & Choudary, S. P. (2016). *Platform revolution: How networked markets are transforming the economy and how to make them work for you*. WW Norton & Company.

Parkhe, A., (1993). Strategic alliance structuring: A game theoretic and transaction cost examination of interfirm cooperation. *Academy of management journal, 36*(4), pp.794-829.

Peirce, C. (1931). *Collected papers*. Cambridge: Harvard Univ. Press.

Peters, G. W., & Panayi, E. (2016). Understanding modern banking ledgers through blockchain technologies: Future of transaction processing and smart contracts on the internet of money. In *Banking beyond banks and money* (pp. 239-278). Springer, Cham.

Platt, C., (2017a). Of permissions and blockchains… A view for financial markets. *Available at:* https://medium.com/@colin_/of-permissions-and-blockchains-a-view-for-financial-markets-bf6f2be0a62

Platt, C., (2017b). Thoughts on the taxonomy of blockchains & distributed ledger technologies. *Available at:* https://medium.com/@colin_/thoughts-on-the-taxonomy-of-blockchains-distributed-ledger-technologies-ecad1c819e28

Pradi, A. (2020). Ports and terminals: The missing element for full optimization. *Available at:* https://www.tradelens.com/post/ports-and-terminals-the-missing-element-for-full-optimization

Rauchs, M., Glidden, A., Gordon, B., Pieters, G. C., Recanatini, M., Rostand, F., Vagneur, K. & Zhang, B. Z. (2018). Distributed ledger technology systems: A conceptual framework. *Available at*: https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/distributed-ledger-technology-systems/#.XkwjwihKj-h

Rauchs, M., Blandin, A., Bear, K., & McKeon, S. B. (2019). 2nd Global Enterprise blockchain benchmarking study. Available at SSRN 3461765. Available at: https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/2nd-global-enterprise-blockchain-benchmarking-study/

Reusen, E., & Stouthuysen, K. (2020). Trust transfer and partner selection in interfirm relationships. Accounting, Organizations and Society, 81, 101081.

Ripple. (2020). Technical FAQ. Validators and Unique Node Lists. *Available at:* https://xrpl.org/technical-faq.html

Robson, C. (2002). *Real world research: A resource for social scientists and practitioner-researchers* (Vol. 2). Oxford: Blackwell.

Rückeshäuser, L. (2017). Do we really want blockchain-based accounting? Decentralized consensus as enabler of management override of internal controls. *Proceedings of 13. International Business Informatics Conference*, 16-30

Schmidt, C. G., & Wagner, S. M. (2019). Blockchain and supply chain relations: A transaction cost theory perspective. *Journal of Purchasing and Supply Management*, *25*(4), 100552.

Shelanski, H. A., & Klein, P. G. (1995). Empirical research in transaction cost economics: a review and assessment. *Journal of Law, Economics, & Organization*, 335-361.

Stokel-Walker, C. (2017). The Blockchain Will Save Healthcare and Shipping Billions of Pounds, *Wired*, Available at: http://www.wired.co.uk/article/blockchain-ibm-hyperledger-business

Strauss, A. & Corbin, J. (1990). *Basics of qualitative research*. Sage publications.

Swanson, T. (2015). Consensus-as-a-service: a brief report on the emergence of permissioned, distributed ledger systems. *Available at:* *https://allquantor.at/blockchainbib/pdf/swanson2015consensus.pdf*

Symon, G.E. & Cassell, C.E. (1998). *Qualitative methods and analysis in organizational research: A practical guide.* Sage Publications Ltd.

Szabo, N. (2017). Money, Blockchains, and Social Scalability. *Available at:* http://unenumerated.blogspot.com/2017/02/money-blockchains-and-social-scalability.html

Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research policy*, *15*(6), 285-305.

Teece, D. J. (1992). Competition, cooperation, and innovation: Organizational arrangements for regimes of rapid technological progress. *Journal of economic behavior & organization*, *18*(1), 1-25.

Telser, L.G. (1980). A theory of self-enforcing agreements. *Journal of Business,* pp.27-44.

The Economist. (2016). Not-so-clever contracts. *Available at:* http://www.economist.com/news/business/21702758-time-being-least-human-judgment-still-better-bet-cold-hearted

Tidström, A. (2014). Managing tensions in coopetition. *Industrial Marketing Management, 43*(2), 261-271.

TradeLens. (2018a). Solution architecture. *Available at:* https://docs.tradelens.com/learn/solution_architecture/

TradeLens. (2018b). Data retention policy. *Available at:* https://docs.tradelens.com/reference/data_retention_policy/

TradeLens. (2019a). Blockchain in logistics: the Unblocked interview. *Available at:* https://www.tradelens.com/post/blockchain-in-logistics-the-unblocked-interview

TradeLens. (2019b). TradeLens adds major ocean carriers Hapag-Lloyd and Ocean Network Express. *Available at:* https://www.tradelens.com/press-releases/hapag-lloyd-and-ocean-network-express

TradeLens. (2019c). Major ocean carriers CMA CGM and MSC to join TradeLens. *Available at:* https://www.tradelens.com/press-releases/major-ocean-carriers-cma-cgm-and-msc-to-join-tradelens

TradeLens. (2020a). CMA CGM and MSC Complete TradeLens Integration and Join as Foundation Carriers. *Available at:* https://www.tradelens.com/press-releases/cma-cgm-and-msc-complete-tradelens-integration-and-join-as-foundation-carriers

TradeLens. (2020b). About. *Available at:* https://www.tradelens.com/about

TradeLens. (2021). TradeLens solution brief 3rd edition. *Available at:* https://s3.us.cloud-object-storage.appdomain.cloud/tradelens-web-assets/Tradelens_Solution_Brief_v3.pdf

Van Hoek, R. & Lacity, M. (2020). How the Pandemic Is Pushing Blockchain Forward. *Harvard Business Review*, *Available at:* https://hbr.org/2020/04/how-the-pandemic-is-pushing-blockchain-forward

Vosselman, E., & Van der Meer-Kooistra, J. (2009). Accounting for control and trust building in interfirm transactional relationships. *Accounting, Organizations and Society*, *34*(2), 267-283.

West, J. (2003). How open is open enough?: Melding proprietary and open source platform strategies. *Research policy*, *32*(7), 1259-1285.

Williamson, O.E. (1985). *The economic institutions of capitalism: Firms, markets, relational contracting*. New York and London: Free Press and Collier Macmillan.

World Economic Forum. (2013). Enabling Trade. Valuing Growth Opportunities. *Available at:* http://www3.weforum.org/docs/WEF_SCT_EnablingTrade_Report_2013.pdf

World Economic Forum. (2017). How blockchain can restore trust in trade. *Available at:* https://www.weforum.org/agenda/2017/02/blockchain-trade-trust-transparency

World Economic Forum. (2020). Inclusive Deployment of Blockchain for Supply Chains: Part 6 – A Framework for Blockchain Interoperability. *Available at* https://www.weforum.org/whitepapers/inclusive-deployment-of-blockchain-for-supply-chains-part-6-a-framework-for-blockchain-interoperability

Xu, X., Weber, I., Staples, M., Zhu, L., Bosch, J., Bass, L., Pautasso, C., & Rimba, P. (2017, April). A taxonomy of blockchain-based systems for architecture design. In *2017 IEEE international conference on software architecture (ICSA)* (pp. 243-252). IEEE. Available at: https://ieeexplore.ieee.org/document/7930224

Yin, R. K. (2009). *Case study research: Design and methods* (5th ed.). Thousand Oaks, CA: SAGE.

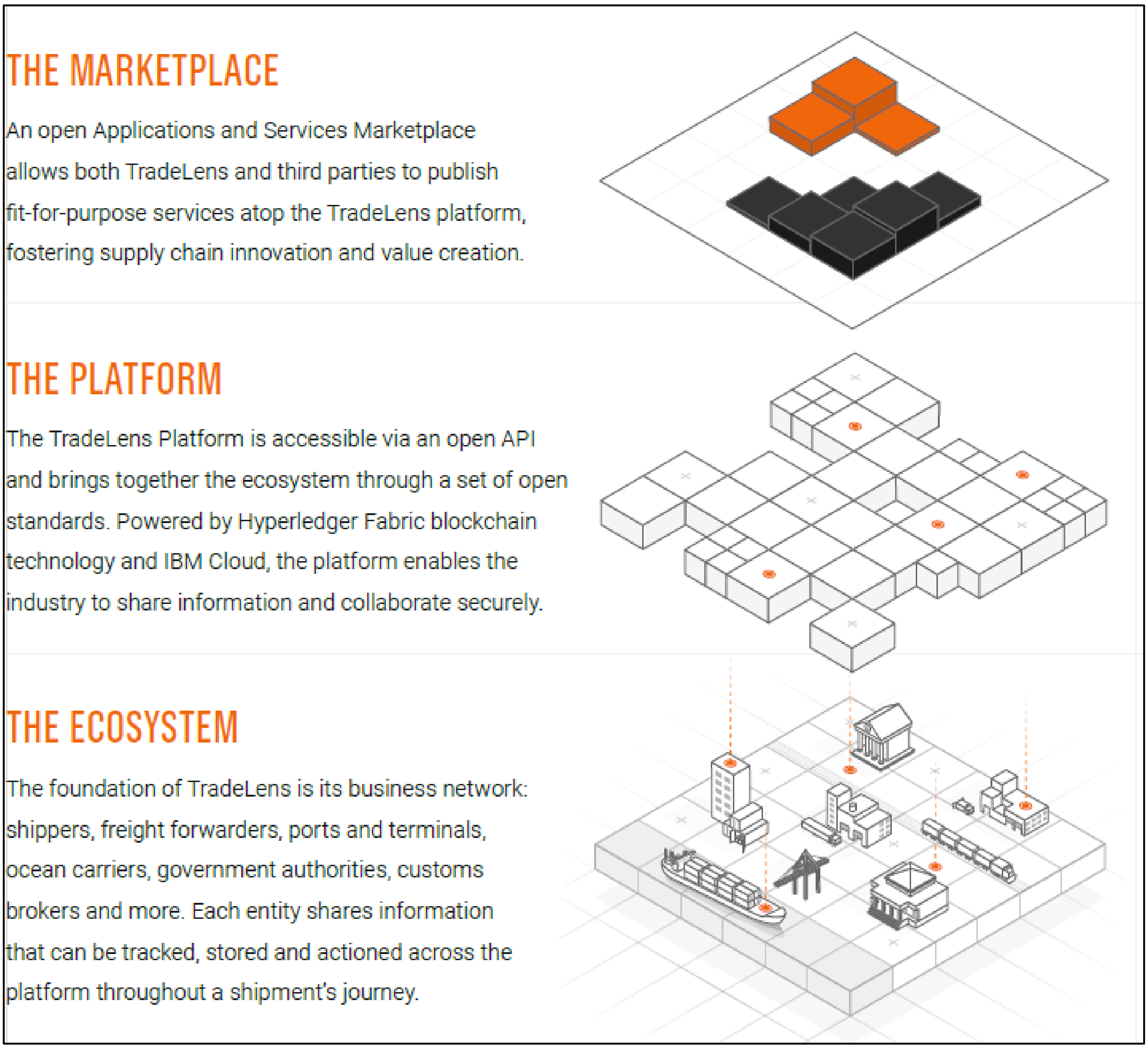
Zajac, E. J., & Olsen, C. P. (1993). From transaction cost to transactional value analysis: Implications for the study of interorganizational strategies. *Journal of management studies, 30*(1), 131-145.

Zavolokina, L., Ziolkowski, R., Bauer, I. & Schwabe, G. (2020). Management, Governance and Value Creation in a Blockchain Consortium. *MIS Quarterly Executive*, 19(1), pp.1-17.

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.

APPENDIX A: Overview of the TradeLens solution

TradeLens can be seen as consisting of three parts: The Ecosystem, the Platform, and the Applications and Services Marketplace (TradeLens, 2021). The Ecosystem refers to a network of supply chain actors sharing and receiving data through TradeLens solution. The platform, powered by IBM Cloud and IBM Blockchain (TradeLens, 2021), provides infrastructure and rules that facilitate and govern interactions between ecosystem members (Eisenmann et al., 2006). Marketplace, built on top of the platform layer, allows both TradeLens as well as third-parties to develop applications and services, and offer them to interested ecosystem participants.



Source: TradeLens (2021)

APPENDIX B: Overview of interviews conducted

Asterisk (*) in the second column marks the interviews, which yielded the most relevant data for this study. Interviews without the asterisk contributed to an understanding of general issues related to building an industry-wide blockchain-based platform, but were not directly related to TradeLens case. In early 2018, for example, two interviews were conducted with an insurance company, which was considering joining B3i[50], a Blockchain initiative within the Insurance Industry. Even though the insurance company ultimately decided to postpone its membership in B3i, the interviews highlighted the difficulties related to developing an industry-wide blockchain solution.

Date	Type	Position	Company	Location
14.2.2018	Interview	Controller and Analyst	Gefion Insurance	Case site (Gefion)
7.3.2018	Interview	Controller	Gefion Insurance	Case site (Gefion)
2.5.2018	Interview*	Digital product manager	Mærsk	Case site (Mærsk)
24.5.2018	Interview*	Lead IT architect	GTD/TradeLens	Case site (GTD/TradeLens)
14.6.2018	Interview	Special consultant/Chief consultant	Ministry of Industry, Business and Financial Affairs	Ministry of Industry, Business and Financial Affairs
3.7.2018	Interview*	Digital product manager	Mærsk	Case site (Mærsk)
6.7.2018	Interview	Head of data and business devlopment	Danish Maritime Authority (DMA)	DMA
14.3.2019	Interview*	Digital product manager	Mærsk	Case site (Mærsk)
4.7.2019	Interview*	Global Head of Integration	APM Terminals	Case site (Mærsk)
10.10.2019	Interview*	CEO, Partner	SeaIntelligence Consulting	SeaIntelligence consulting
21.10.2019	Interview*	Digital product manager	Mærsk	Case site (Mærsk)
30.3.2020	Interview*	Digital product manager	Mærsk	Online/Zoom
31.3.2020	Interview*	Head of Strategy and Operations	GTD/TradeLens	Online/Zoom
20.5.2020	Interview*	CDIO (MSC); Chairman (DCSA)	MSC/DCSA	Online/Zoom
26.5.2020	Interview*	Project (Stream) Lead at Global International team	Anheuser-Busch InBev	Online/Zoom
26.5.2020	Interview*	Vice President, Blockchain Solutions	IBM	Online/Zoom
10.6.2020	Interview*	President/CEO	Global Container Terminals Inc.	Online/Zoom
7.7.2020	Interview*	Various departments	Pacific International Lines	E-mail[10]
3.9.2020	Interview*	CTO	Youredi	Online/Zoom
9.9.2020	Interview*	CIO	YILPORT holding	Online/Zoom

[50] For more information see https://b3i.tech/home.html

[10] Interviewees from Pacific International Line were not available for in-person interview. The interview questions were replied via e-mail.

APPENDIX C: Overview of conferences and webinars

Date	Type	Title	Organizer	Location
4.11.2017	Conference participation	Nordic Blockchain conference	ITU Copenhagen	ITU Copenhagen
18.4.2018	Conference participation	Blockchain conference and exhibition	Blockchain Expo World Series	Olympia London
18.6.2019 - 20.6.2019	Conference participation	TOC Europe	TOC Events Worldwide	Ahoy, Rotterdam
11.11.2019	Conference participation	SHIP TECH: Conference on the future of shipping	ShippingWatch/Relevent	Copenhagen
19.2.2020	Webinar	Learning about DCSA's Track & Trace standards	DCSA	Online
12.5.2020	Webinar	Digitalisation and data standardisation: time for the maritime industry to act	Maritime Optimization and Communications	Online
26.5.2020	Webinar	Adjusting to the 'New' New Normal: The Impact of COVID-19	TOC Events Worldwide	Online
9.6.2020	Webinar	Accelerating Digitalization: The role of start-up tech in post-COVID-19 supply chains	TOC Events Worldwide	Online
3.7.2020	Webinar	Where next for global shipping?	CBS Executive MBA in Shipping and Logistics	Online
14.7.2020	Webinar	Global Overview of the Container Shipping Market	Intermodal Digital Insights	Online
15.7.2020	Webinar	Global Smart Container Forum	Intermodal Digital Insights	Online
5.8.2020	Webinar	An electronic bill of lading, considered the holy grail of the maritime industry	IBM Blockchain/TradeLens	Online
12.8.2020	Webinar	How 3PLs and FFWs move from linear logistics to a platform business model	IBM Blockchain/TradeLens	Online
19.8.2020	Webinar	BiTA + TradeLens: Alignment & Opportunities Moving Forward	FreightWaves	Online

APPENDIX D: Overview of the secondary data sources

Outlet	Webpage
TradeLens webpage	https://www.tradelens.com/
TradeLens blog	https://www.tradelens.com/blog
TradeLens press releases	https://www.tradelens.com/blog/all-press-releases
TradeLens documentation	https://docs.tradelens.com/
GTD Solution webpage	https://www.gtdsolution.com/
Digital Container Shipping Association (DCSA)	https://dcsa.org/
JOC.com (Container shipping and trade news and analysis)	https://www.joc.com/
Coindesk	https://www.coindesk.com/
Ledger Insights	https://www.ledgerinsights.com/
Wired	https://www.wired.co.uk/
World Economic forum	https://www.weforum.org/
LinkedIn posts	https://www.linkedin.com/
Twitter Posts	https://twitter.com/
IBM Blockchain	https://www.ibm.com/blockchain
PWC	https://www.pwc.com/gx/en/industries/technology/blockchain/blockchain-in-business.html
Coin Telegraph	https://cointelegraph.com/
The Loadstar	https://theloadstar.com/
Container news	https://container-news.com/
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Supplychain dive	https://www.supplychaindive.com/
Global Trade review	https://www.gtreview.com/
Globe newswire	https://www.globenewswire.com/en
Logistics Middle East	https://www.logisticsmiddleeast.com/
Seatrade Maritime News	https://www.seatrade-maritime.com/
Port Technology	https://www.porttechnology.org/
Express Computer	https://www.expresscomputer.in/
Container Management	https://container-mag.com/
The Maritime Executive	https://www.maritime-executive.com/
BTC Manager	https://btcmanager.com/
PR Newswire	https://www.prnewswire.com/
Splash247.com	https://splash247.com/
Business Blockchain HQ	https://businessblockchainhq.com/
Forbes	https://www.forbes.com/
Market Research Reports	https://www.marketresearchreports.com/maritime
Harvard Business Review	https://hbr.org/
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