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The case of importing tires to the Netherlands using TradeLens

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Realizing value from voluntary business-government information sharing through blockchain-enabled infrastructures: The case of importing tires to the Netherlands using TradeLens

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ABSTRACT

Blockchain technology has emerged as new technology and governments are now exploring its potential for realizing value. In recent years, studies have focused on identifying opportunities and barriers of blockchain-based applications for government, and multiple piloting initiatives have been started to experiment and test the potential of this technology. Nevertheless, many of these blockchain initiatives are in the pilot stage. For the initiatives that have reached a large-scale implementation or production stage, these are largely on a local (municipal) or national level. There is limited research on operational blockchain-enabled infrastructures implemented on a global level and how they can be used by government organizations to create value. This is an area that we set out to explore with this paper. In this paper, we take the specific focus on business-government information sharing via a global blockchain-enabled platform (TradeLens) to create value for business and government. As a case study, we focus on examining the case of importing tires from China to the Netherlands and the value creation processes for the tire importer and customs enabled by information sharing via the TradeLens platform. From a theoretical perspective, building on two models that have been published earlier, we propose a framework that explicitly allows to link and reason about business-government information sharing enabled by blockchain, how it enables value creation for both business and government, and the technical blockchain design choices that are linked to this value creation process.

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CCS CONCEPTS

• **Information systems**; • **Information systems applications**; • **Enterprise applications**;

KEYWORDS

Data sharing, Value, Business-government, International trade, Blockchain

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1 INTRODUCTION

Blockchain technology has emerged as new technology (Nakamoto, 2008) and governments and businesses are exploring the potential of this technology and the benefits and value it can bring. In recent years, studies have focused on identifying opportunities and barriers of blockchain for the government (e.g. Ølnes et al., 2017; Segers et al., 2019). Next to that, multiple piloting initiatives have been started to experiment and test the potential of this technology. Alexopoulos et al., 2019, for example, identified blockchain initiatives in which different governments are involved and classify these initiatives by looking at the government involved, the application level (e.g. municipal, national), the technology readiness (e.g. pilot, completed pilot, (on-going) large-scale implementation, production), as well as the application domain (e.g. academic certificates, identity management, IDs, financial, healthcare, voting, immigration, land registry and legislation). Many of these blockchain initiatives are in the pilot stage. Those that have reached a large-scale implementation or production stage are blockchain initiatives at a local (municipal) or national level (see the overview of Alexopoulos et

al., 2019). Research into blockchain infrastructures at a global level that are in operational use and how they can be used by government organizations to create value is limited. This is an area that we set to explore with this paper. We especially focus on examining how value can be realized for business and government (in our case customs) from voluntary business-government information sharing through a global and operational blockchain-enabled digital trade infrastructure[1] (in our case TradeLens) and what are related technical blockchain design choices that enable this value creation. Theoretically, the motivation for this study is linked to two streams of literature, namely (1) the literature on voluntary business-government information sharing to create public value; and (2) the literature on blockchain in general and blockchain governance in a business-government context in particular. Empirically, the motivation for this study is to (1) examine cases of blockchain platforms, which have gone beyond the pilot stage and are now in operation and use, and (2) to focus on blockchain platforms that are global in nature, rather than of local (municipal) or national nature.

The remaining part of this paper is structured as follows. In Section 2, we introduce background literature related to the theoretical perspectives which motivated our study. Next, building on two models from earlier research, we propose a framework that allows linking value from business-government information sharing and the underlying blockchain technical design choices. The background information about our empirical setting and the case study method that we followed are discussed in Section 3. In Section 4 we present our findings. In Section 5 we discuss our findings from a broader perspective, and we end the paper with conclusions.

2 THEORETICAL BACKGROUND

2.1 Literature review

2.1.1 Voluntary business-government information sharing to create public value. Our motivation to focus on business-government information sharing to create public value is rooted in a stream of research in the eGovernment literature that we briefly discuss here. Through the digitization of government, e-government research has set attention to information sharing that crosses organizational boundaries (Dawes, 1996; Yang and Maxwell, 2011). Almost a decade ago Gil-Garcia, 2012 advocated that there is a potential for government organizations to generate public value if they broaden the information sharing beyond the single level of government by also including information from businesses and not-for-profit organizations. Rapid digitization led to the design of digital infrastructures and platforms that contain a wealth of information that may be of great value for governments. More recent research explored the area of business-government information sharing to create public value. For example, research on data collaboratives focuses on data sharing among stakeholders from various sectors to create public value (Verhulst and Sangokoya, 2015; Susha et al., 2017; Verhulst et al., 2017; Susha and Gil-Garcia, 2019).

However, apart from the data that businesses are legally obliged to share with the government, it is very difficult for governmental organizations to make use of the wealth of business information that resides in business infrastructures and platforms unless this data is shared voluntarily. In practice, such voluntary information sharing is not straightforward: research shows that voluntary sharing arrangements rely on clear incentives for businesses to share their data (Gascó et al., 2018). Other studies address the diverging interests and costs associated with voluntary sharing as well as different motivations for parties to enter into voluntary sharing initiatives (Susha and Gil-Garcia, 2019). Recently, Rukanova et al., 2020 developed a framework for understanding voluntary information sharing to create public value. This framework provides a rich conceptualization for understanding the context of voluntary information sharing in terms of actors and systems involves, as well as the factors and governance processes that influence value creation. This framework, however, treats the underlying technical infrastructure largely as a black box and does not take blockchain into account. An important condition for realizing public value from shared business data is the concept of trust in the data and the quality of the data. For auditability and reliability, governmental organizations need to be sure that the data has not been tampered with. These data requirements can be addressed by using blockchain technologies in which immutability and auditability are taken care of through its technological design, and therefore it is important to understand the technical design choices. Therefore, while the framework of Rukanova et al., 2020 is useful to understand voluntary information sharing and how it can relate to value, it needs to be extended to capture blockchain technology and the underlying technical design choices explicitly.

2.1.2 Blockchain and blockchain governance in the context of business-government information sharing. Blockchain technology was initially introduced in the context of the cryptocurrency Bitcoin (Nakamoto, 2008) and later on the blockchain technology was generalized towards other application domains. Blockchain technology is a distributed ledger technology (DLT). In contrast with a central ledger managed by a trusted intermediary, each party in the blockchain-based information infrastructure holds its own copy of the ledger, therefore challenging the role of the trusted intermediaries (Pilkington, 2015; Drescher, 2017). Several features of blockchain hold the potential to be particularly useful for business-government information sharing, such as a high level of transparency, immutability and reliability (van Engelenburg et al., 2020; Segers et al., 2019; Ølnes et al., 2017). van Engelenburg et al., 2020 developed a blockchain governance framework, which allows linking stakeholder requirements to blockchain design choices by using blockchain governance requirements to link the stakeholder and the technical view. This framework is very suitable to make the underlying blockchain technology design choices explicit and can provide a useful addition to the framework of Rukanova et al., 2020. While these two frameworks in isolation cover different aspects, by combining them it will become possible to reason and provide an explicit link between the value from the information sharing and the underlying blockchain technological design choices. In the next section, we provide further details on the two frameworks and how we build upon them to arrive at a new framework that we will use as a conceptual lens for our analysis.

[1]For further elaboration on digital trade infrastructures, see the digital trade infrastructure framework (Rukanova et al., 2018, 2018)

2.2 Conceptual framework

Understanding voluntary business-government information sharing arrangements requires an understanding of the context of the information sharing in terms of actors and IT systems involved and identification of related benefits. To this end, Rukanova et al., 2020 developed a comprehensive framework for analyzing the benefits of voluntary business-government information sharing. In their framework, they include: (1) the context of inter-organizational information sharing in terms of business and government actors (nationally and internationally and their IT systems); (2) the factors that serve as barriers, drivers and enablers for the voluntary sharing; (3) governance and alignment processes to make the voluntary sharing happen, (4) the value from the voluntary sharing in terms of benefits for businesses and government. In their framework the context analysis is limited to identifying relevant digital infrastructures that enable voluntary sharing, however, the underlying technology design choices related to the digital infrastructure are treated as a black box. To analyze the effect of blockchain technical design options, we use the framework developed by van Engelenburg et al., 2020 which consists of the following components[2]:

(1) Stakeholder view which focuses on different stakeholders involved in the information-sharing arrangement, such as businesses, government, technology providers and standardization organizations[3].
(2) Blockchain control view: this view captures the blockchain control points and different technological design choices that can be made for each of the control points. These control points can be related to:
   (a) The data and where it is stored (e.g. on-the blockchain or off-the blockchain). In the case of on-the-chain storage, relevant aspects are that data can be transparent, authenticated and encrypted. In the case of off-the-chain storage, the data that is stored on the chain provides a proof of existence of data that is stored somewhere else. Understanding where data is stored is very important. In ideal situations, the data can be stored on the blockchain and then every party that is part of the blockchain network will have the exact same copy of the information. But for scalability purposes, such a solution may not be feasible (Tan et al., 2019) and the alternative is to store the data off- the-chain: only a hash pointer[4] of the data is stored on the chain;
   (b) A second blockchain control point is the consensus mechanism according to which new information is stored on the blockchain. A variety of consensus mechanisms can be used in blockchain-based applications and this control point helps to make explicit which of the consensus mechanisms is applied;
   (c) The third blockchain control point is the network topology. Different kinds of network topologies are available for blockchain-based platforms. For example, a public network is a network that can be open to everyone. A private network, on the other hand, can be restricted to a selection of stakeholders that have access to the network.
(3) Governance requirements, which link the Stakeholder view and the Blockchain control view. The governance requirements describe the rights that stakeholders should have according to the stakeholder view and the rights that they can exercise according to the control point view. Building on Constantinides, 2012, three types of rights are included: (a) constitutional rights: who may or may not participate in making collective choices; (b) collective choice rights: rights concerning users and components within the information system; and (c) operational rights: rights related to access to the information system and reading and adding data.

Building on the frameworks of Rukanova et al., 2020 and van Engelenburg et al., 2020, we developed a conceptual framework that explicitly establishes the link between the technical design choices and value (see Figure 1). The context and the value in terms of benefits (blocks 1 and 2) of Figure 1 is a simplified representation of the context and benefits view of Rukanova et al., 2020. In our conceptualization, we explicitly included the concept of blockchain to denote the blockchain infrastructures in block 1 in Figure 1 to highlight our interest in blockchain-based applications. Blocks 3 and 4 at the bottom part of Figure 1 are an adaptation from van Engelenburg et al., 2020, focusing on the governance requirements and the Blockchain control view.

The combined conceptualization as illustrated in Figure 1 allows to explicitly establish the link between the information sharing context (block 1) and value (block 2), and blockchain design choices (block 4) through government requirements (block 3). We will use this framework for the case analysis.

3 METHODOLOGICAL APPROACH

3.1 Case study approach

In this study, we apply an interpretative case methodology (Orlikowski and Baroudi, 1991; Klein and Myers, 1999; Walsham, 1993). Interpretive studies are "aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context" (Walsham, 1993, p. 4-5). The context of our study is voluntary business-government information sharing enabled by blockchain to create value. We are particularly interested in understanding how the underlying technical design choices of the blockchain infrastructures used in the voluntary business-government information sharing is linked to the value of the information that is shared.

3.2 Case background

Our case is in the domain of international trade and logistics in which massive amounts of data are created for the numerous stakeholders that are involved in the shipping of goods around the globe. In this domain, governmental organizations are involved in the collection of tax and duties as revenues for providing public services, for trade facilitation, for enhancing economic competitiveness, and

[2]For simplicity purposes here we describe the components of the framework on a high level. Further explanation of these concepts can be found in Susha and Gil-Garcia, 2019.
[3]The stakeholder view of Susha and Gil-Garcia, 2019 and the context view of Rukanova et al., 2017 are closely related and this allowed us to establish the link between these two models in our conceptualization.
[4]A hash pointer contains a hash of the documents and a link to where the document is stored. The hash is a code that is unique to the document. Therefore, if the document changes, it does not fit the hash anymore. This allows users to check whether the document has been tampered with after the hash was stored.

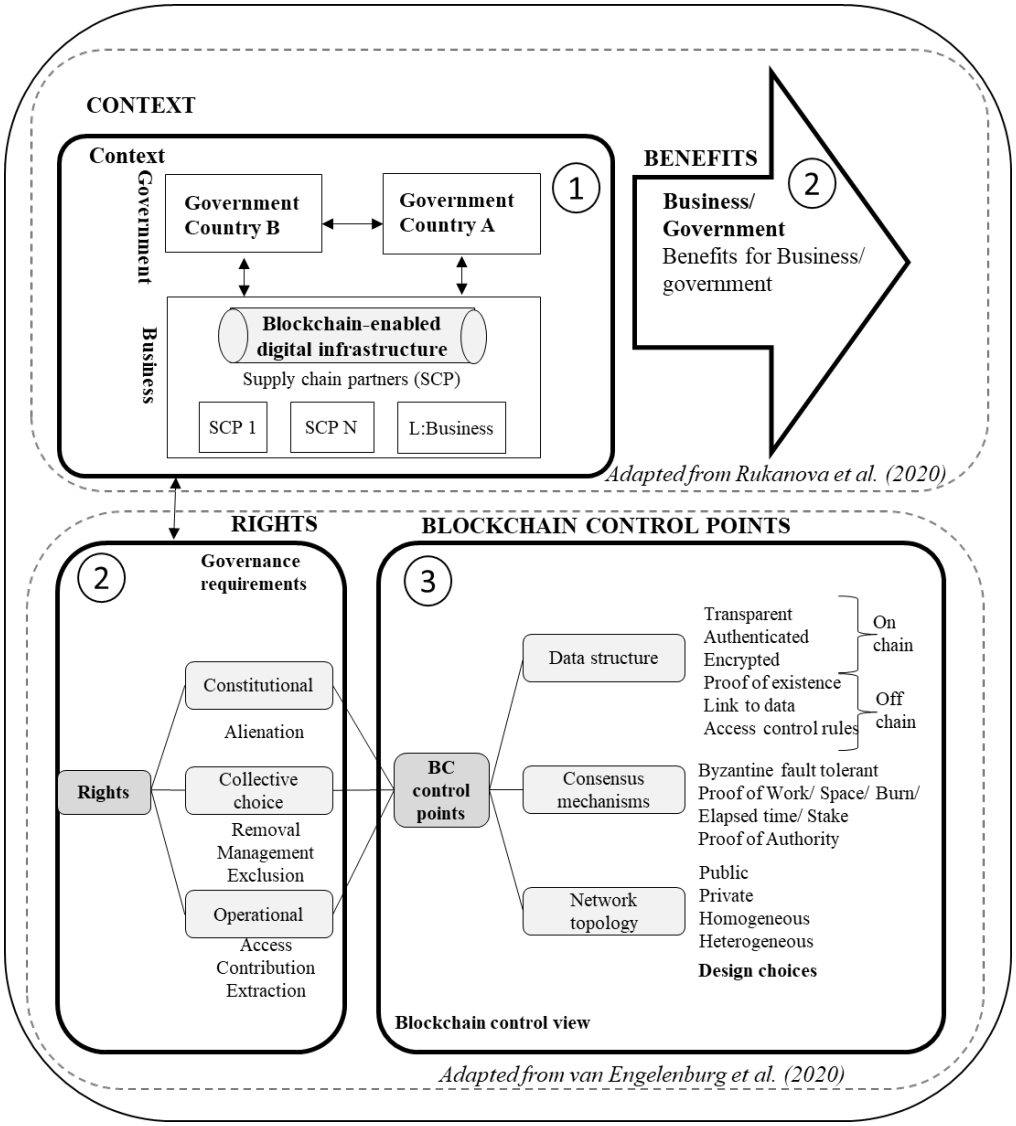

Figure 1: A framework for blockchain-enabled business-government information sharing to create value

for ensuring the safety and security of citizens. Governments are exploring how they can use data analytics and combine business and government data to improve their customs risk assessment processes and to realize public value such as better revenue collection or increased safety and security (Rukanova et al., 2019; Rukanova et al., 2021).

On the business side, Van den Ban[5] is an international car tire distributor with local warehouses and offices in different parts of Europe, with annual sales of around 8 million car tires. It has more than 300 employees and has developed a highly professional logistics network in Europe. Van den Ban purchases a significant amount of car tires from a US company that acts as the seller. The US company in its turn orders the tires from Chinese suppliers. The goods are loaded on a ship in China and brought to a transshipment port in Malaysia, where they are unloaded and loaded on another vessel (currently of the same carrier) for transport to Europe.

When the goods arrive in Europe the first port of entry in the European Union (EU) is in Antwerp, Belgium. The Belgian Customs perform the first customs clearance procedure, based on the safety and security declaration (ENS) submitted by the carrier, related to safety and security for entering of the goods in the EU. Subsequently, the ship travels from Antwerp to Rotterdam in the Netherlands, where the Van den Ban containers are unloaded. In the Netherlands, the second customs procedure starts: Van den Ban submits the so-called import declaration for the collection of import duties by Dutch customs.

[5]https://www.vandenban.nl/

For the digital infrastructure, TradeLens is a global blockchain-enabled platform that is now in commercial use. It was developed by IBM and GTD Solution, a subsidiary of A.P. Moller Maersk. This platform allows supply chain partners such as sellers, carriers, terminals etc., to share business documents (such as commercial invoices, packing lists and Bill-of-Lading) or logistics events (such as loading of a container on the ship and arrival at a port) with other relevant supply chain partners. Additionally, businesses can, voluntarily, share information available on the TradeLens platform with the relevant government authorities (e.g. with customs of the importing or the exporting country).

The TradeLens platform is not part of the obligatory systems which are used by businesses for obligatory reporting to authorities. TradeLens is designed to be a neutral industry platform rather than a proprietary solution. Traditionally carriers are afraid that their data may be viewed by their competitors. Therefore, in the design of TradeLens, a choice was made to use so-called channels, where each carrier has its own channel and parties that are part of different channels cannot access each other's data. At the moment (January 2021) only carriers and TradeLens can be nodes in the network but in the future, other parties like freight forwarders may also become nodes. Other supply chain parties can use TradeLens services and access data if allowed to do so without having to have their own node but via the services of the TradeLens node.

When joining TradeLens, as part of the contractual agreement, businesses agree voluntarily that their information can be made available to the relevant authorities that are involved in controlling the goods in their trade lanes. In the case under analysis, the businesses involved are willing to voluntarily share their data with Dutch Customs, as the goods are imported via The Netherlands. In the case analysis, we will further discuss the benefits of this voluntary sharing and the relationship with the underlying technical design choices.

3.3 Data collection and data analysis

We used different sources for the data collection. More specifically we conducted one dedicated workshop with representatives from IBM (TradeLens experts) and Van den Ban (Customs & Trade Compliance Manager) to understand the import processes and contractual relationships among the supply chain partners, the underlying technological choices of the TradeLens platform, and potential benefits for Van den Ban. Subsequently, two follow-up workshops were conducted with experts from the Dutch Customs (a senior scientist, a customs innovation expert, a manager trade relationships and data analytics experts) and the IBM team (two data analytics experts and two managers) and the research team to understand the benefits for government.

Additionally, document analysis was performed including analysis of key documents such as the Bill-of-Lading, the commercial invoice, the packing list, screenshots of the customs software with which Van den Ban submits the customs declarations (called Softpak), and documents showing how TradeLens data is used to generate the import declaration via the Van den Ban's Softpak system. Furthermore, PowerPoint presentations were reviewed in which Van den Ban articulated the context of the business process and the benefits of integration with TradeLens. Notes were taken and a working document with the initial findings was circulated for identifying inaccuracies and missing points. This process was repeated in a number of iterations until any inaccuracies were removed and missing information was added. This allowed gaining a very rich understanding of the information sharing process. The data analysis was performed iteratively, through the conceptual framework presented in Section 2 (Figure 1).

4 CASE ANALYSIS

Figure 2 provides an overview of our case analysis. We will explain Figure 2 and the related findings as follows. First, in section 4.1, we discuss the context analysis (see block 1 in Figure 2). Subsequently, in section 4.2, we focus on value creation and benefits (see block 2 in Figure 2). Finally, in section 4.3, we discuss the underlying blockchain design choices (see blocks 3 and 4 in Figure 2).

4.1 Voluntary business-government information sharing context: actors and IT systems

We first analyze the context for understanding the key actors and their related IT systems. We discern three main types of stakeholders: businesses, government, and IT providers. In our case, the key business stakeholders that play a role in voluntary information sharing are the seller, the carrier, and Van den Ban (the Dutch car tire importer). In Figure 2 (see block 1), we provide an overview of the actors and related IT systems involved in the case. At the moment (January 2021), one carrier is responsible for the full route: for the original vessel picking the container from China to the trans-shipment port in Malaysia, and for the second part of the journey where the container is loaded onto another vessel in Malaysia for the journey towards Europe. On the government side, Belgian Customs is responsible for the customs entry (safety and security) clearance and Dutch Customs is responsible for the import clearance. These parties are in a supervisory role. In this case, we will focus on Dutch Customs as the party directly involved in the voluntary information-sharing arrangement. At the supranational level, the EU sets the laws and regulations for international trade and logistics (such as the Union Customs Code).

On the IT side, the TradeLens blockchain-enabled platform is provided by IBM and GTD Solution, where IBM is responsible for the technical development and the additional cloud services for the document storage. The TradeLens platform is built on the foundations of the Hyperledger blockchain infrastructure. In Figure 2, we also show that the seller creates the commercial invoice and the carrier provides the Bill-of-Lading respectively available to the TradeLens platform. These documents are stored on the secure document store of the IBM cloud and hash pointers to the documents are stored on the blockchain of the TradeLens platform. The interface that IBM is developing allows for automatic retrieval of relevant data fields from the commercial invoice and the Bill-of-Lading that are made available to the TradeLens platform and mapping them to the correct fields in the customs declaration software of Van den Ban (Softpak). In this respect, IBM can be seen as an application provider developing value-added services to Van den Ban based on data from the TradeLens platform. Subsequently, this declaration is

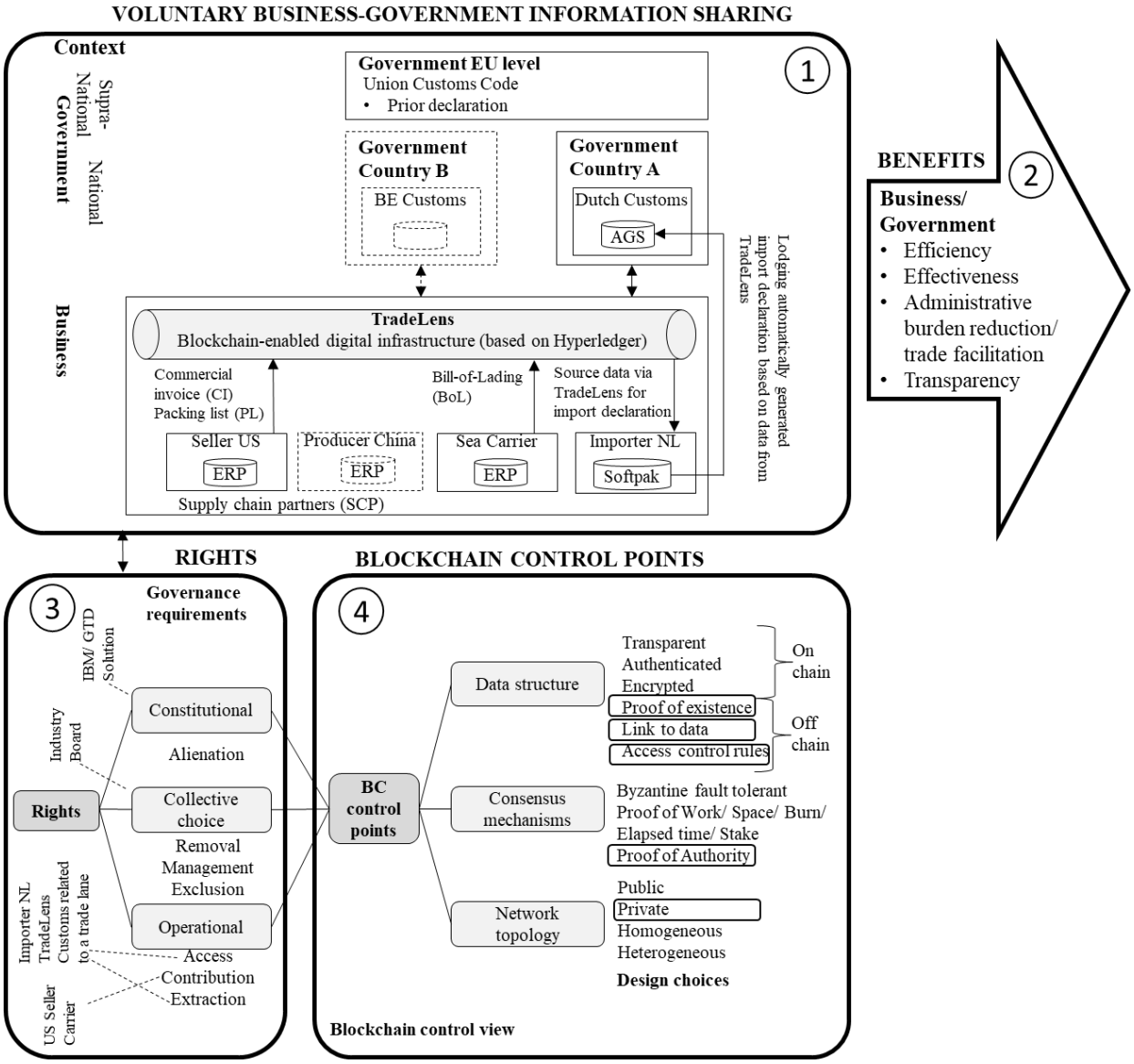

Figure 2: Summary of the case findings

submitted via Softpak to the customs declaration system (AGS) of Dutch Customs.

It seems that Dutch Customs does not need to have any direct link with the TradeLens system. This is an interesting aspect, because looking from a purely operational point of view, the customs declaration is composed based on data available from TradeLens and via the Softpak systems and submitted directly to the customs declaration system (AGS) of Dutch Customs. That is true when looking purely at how the customs declaration data flows to Dutch Customs. However, for this advanced declaration data to be of value for the Dutch Customs for performing earlier risk assessment and for granting trade simplification benefits associated with concepts such as trusted traders and trusted trade lanes (Heijmann et al., 2020) Dutch Customs needs to: (1) have good visibility into the TradeLens system to gain assurances that the data on which the declaration is based can be trusted and has not been tampered with, and (2) have an understanding of how this TradeLens data is then used to compile the import declaration in Softpak. This is needed for auditing purposes. We turn to the value creation in the next section.

4.2 Value creation

In this section, we reflect on the value creation from voluntary business-government information sharing from the point of view of Dutch Customs, as well as from the point of view of Van den Ban. The benefits for business and government from voluntary

information sharing are listed on the right-hand side of Figure 2 (see the block 2). In our case, Van den Ban shares exactly the same information that they are legally required to share with Dutch Customs, so in terms of data, no additional data is shared with Dutch Customs. The voluntary aspect is the willingness to share the customs declaration data several weeks in advance before Van den Ban is legally obliged to share that data with customs. Normally customs receives the import declaration when the ship arrives in the national port of destination (in our case in The Netherlands), which leaves a small time window for Dutch Customs to perform their risk analysis, allocate means of inspection, and avoid delays in goods delivery. This links to the dual role of customs where they have to control the trade flows but at the same time ensure trade facilitation and economic competitiveness.

Early sharing of data with customs is one of the key benefits for customs. Additionally, customs declarations often contain incomplete information. In such cases, customs will request the business parties to provide additional business data so that customs can cross-validate the customs declaration against business documents such as the commercial invoice and the packing list. In the Van den Ban case, there is no need to ask for these business documents as the customs declaration is generated automatically based on these business documents and customs can check exactly how source data available via TradeLens has been used in the Softpak software to generate the import declaration. Therefore, in this case, there is no need for Van den Ban to provide additional information for cross-validation purposes. This leads to additional efficiency gains for both Van den Ban and Dutch Customs as there is no need for additional activities and there are no potential delays on both sides for providing additional data for cross-validation.

Another benefit is rooted in the enhanced reliability and early lodging of the customs declaration that supports customs organizations to work more efficiently and effectively to avoid peaks. Since the new customs legislation in the EU, the so-called Union Customs Code, came into force in 2016 companies are allowed to lodge import declarations in advance (this can be up to 30 days before the goods are discharged, in our case in the port of Rotterdam). In practice, however, these pre-lodged declarations are often subject to change. The reason is that businesses do make use of the possibility to pre-lodge declarations but while the goods are travelling they are allowed to make changes, e.g. as goods can be re-sold during transport, and hence ownership changes. These changes in declarations occur because businesses lodge the declaration based on preliminary business documents and perform adjustments when they receive the final documents. Every time an adjustment is made the declaration needs to be risk assessed again via the customs risk assessment software. Given the huge volumes of declarations that are handled by the customs IT systems, these repetitions put an additional burden on the IT systems. Therefore, even though there are companies pre-lodging declarations in advance, Dutch Customs is reluctant to consider these as the final declarations and reluctant to base their risk analysis on them. In contrast, in the Van den Ban case, all final documents are already available in the TradeLens system two days after the ship leaves the port in China. These are the same documents on which Van den Ban files the import declaration. This entails that these documents are not updated during shipment. Second, the blockchain functionality allows establishing an audit trail of the document that is used for the import declaration and when a change of the document is made it is recorded on the blockchain and allows for an audit trail.

These functionalities make the pre-lodged declaration interesting for customs risk analysis. If such reliability of the information based on which the pre-lodged declaration is generated is not available, this information would not be of value for their risk assessment purposes. This shows that in this case, features of the underlying technology plays a role in the voluntary sharing arrangement: i.e. early availability of the final documents such as the commercial invoice on the TradeLens platform and the blockchain feature to ensure an audit trail and immutability of the documents on which the declaration is based. In the next section, we go a step further in understanding the technical design choices related to the underlying technical infrastructure.

To summarize, the value creation of the voluntary data-sharing arrangement leads to gains in efficiency, effectiveness, more transparency and the reduction of administrative burden. The arrangement supports the role of Dutch Customs to control the flow of goods but at the same time to provide trade facilitation to legitimate trade, contributing to economic competitiveness.

4.3 Understanding the underlying blockchain design choices

An important condition for realizing public value is the concept of trust in the data and the quality of the data, as for auditability and reliability, governmental organizations need to be sure that the data has not been tampered with. We will now use blocks 3 and 4 of our framework to gain visibility on how these assurances on the reliability and auditability of the data are visible in the technical design choices embedded in the platform that is used for the information sharing (in our case TradeLens). We can start by examining the rights (block 3 in Figure 2), which provides visibility into how the blockchain infrastructure is governed in terms of constitutional, collective choice and operational rights.

Regarding the constitutional rights, the TradeLens platform is owned by IBM and GTD Solution. It is important to clarify that IBM also offers cloud-based secure data storage for companies using TradeLens, but formally this is not TradeLens. It is an additional commercial service, and all users are free to use their own secured databases for storing their trade documents. However, it is part of the membership contract with TradeLens that specific trade documents are always made available; namely the Bill-of-Lading, the packing list and the invoice. Also, all customs administrations that are part of a trade lane always have access rights to these documents related to that particular trade lane.

Although TradeLens is owned by IBM and GTD Solution, per design, the idea behind the TradeLens platform is that it will serve as a neutral platform. This is reflected in the way the collective choice rights are set: other carriers can join and participate in collective choices made related to the TradeLens platform (e.g. choice of standards or other technical design choices). These collective choices are made by the TradeLens Industry Board. At the moment we see that, in addition to Maersk, other major carriers like MSC have joined the TradeLens Industry Board. This shows that the platform is moving towards a neutral platform, allowing different competing

carriers to join and participate and have collective choice rights via the Industry Board. Future research can follow how the collective choice rights are further shaped and evolve as more carriers join.

Regarding the operational rights, the US-based seller and the carrier have contribution rights to provide data to TradeLens. Van den Ban and IBM have the rights to access and extract the information provided by the US seller and the carrier for the specific data related to the Van den Ban activities from the TradeLens platform. By joining TradeLens businesses agree voluntarily that relevant authorities related to their trade lanes can have access to relevant business information available via TradeLens (such as Bill-of-Lading, commercial invoices and packing lists). It is important to clarify that IBM is providing secure document storage but is not allowed to view the content of the data unless agreed otherwise (e.g. for specific support issues).

For the blockchain control view, we look deeper into the technological blockchain design choices in the TradeLens platform (see block 4 in Figure 2). This allows gaining visibility on how the auditability and immutability assurances are embedded in the system. Regarding the data structure, TradeLens opted for an off-the-chain solution, where the data is stored in a secure cloud document storage of IBM. What is stored on the blockchain of TradeLens is the hash pointer to the document, containing a hash of the document and a link to the location where the document is stored in the secure document storage. Because of this choice, carriers participating in TradeLens can decide where exclusion rights (one of the collective choice rights) are for their data. In other words, they can decide who has the right to decide who can access the data. For example, if they keep the data in their own system they retain their exclusion rights but they can also decide that they trust a secure document storage provider to control, access, and store their data there. The blockchain network of TradeLens is a permissioned network. The consensus mechanisms for adding new blocks on the chain is based on proof-of-authority, meaning that only authorized parties can add new blocks to the chain. These are thus the parties that have contribution rights. In terms of network topology, the TradeLens platform is a private network that is owned by IBM and GTD Solution and in correspondence with that, they have constitutional rights. By having visibility in the governance requirements and the technical blockchain design choices, it becomes possible for customs to gain more visibility and assurances about auditability, about the quality of data and that it has not been tampered with. And these assurances are of key importance for customs to trust the data to see value in the data and gain benefits as discussed in Section 4.2.

5 DISCUSSION ON IMPLICATIONS OF THE FINDINGS FOR MORE COMPLEX CASES

Our case analysis shows that in voluntary business-government information sharing the underlying technical infrastructure and related design choices are related to the value creation based on the data-sharing arrangement. In our case, the availability of the data in advance is the benefit but it is only of value if there are assurances that the data in the pre-lodge declaration is based on information that is reliable so that customs can base their risk assessment on it. This reliability includes assurances that the data comes from the source (e.g. the commercial invoices come from the seller), that they have not been tampered with and that there is a clear view on how this information is then used in the Softpak system of Van den Ban to derive the declaration. The blockchain feature of TradeLens creates an audit trail which is a key technical feature to provide assurances on the immutability of the data. Therefore, the feature for ensuring the immutability of data is key in this case in the process of generating public value. In our case, by looking at the technical design choices this is ensured by off-the-chain storage of documents and on-the chain storage of proof of existence links to the documents via hash-pointers, and access control rules. The consensus mechanism is based on proof-of-authority and the data is shared via a private permissioned blockchain network. Also, as the data comes from the source and the immutability is ensured via the audit trail on the blockchain, there is no need for customs to require additional trade documents for cross-validating the data on the customs declaration, as the declaration already contains high-quality data from the source documents.

A fundamental feature of the blockchain-enabled platform that is often addressed in the literature is the added value of removing a trusted intermediary in the information exchange chain. This decentralized aspect is often discussed without questioning whether there is a good reason to eliminate the trusted third party. As we see in our case, in the international trade domain it may be sufficient to have a very limited number of nodes for the blockchain solution to add value. The value of blockchain technology is not so much in having a highly decentralized system or a high number of nodes (in fact the number of nodes in the case of TradeLens are limited). The value added in our case is that the blockchain-enabled platform can secure the audit trail which is very important for government for auditability and reliance on the immutability of documents for risk assessment purposes. Our case, therefore, suggests that for business-government information sharing and logistics, the blockchain solutions do not necessarily need to be highly decentralized to provide value. This discussion on the required degree of centralization/decentralization in the context of blockchain technology for business-government information sharing in international trade can be a subject for further research.

We do need to point out that the case that we discussed in this paper represents a simple setting of one standard product (car tires), relatively simple shipment (a full container with the same product and one carrier for the entire journey), which is sent to the same importer (Van den Ban). Even in this simple setting for the information that is shared to be of value, government already needs assurances about the audit trail and immutability of the data. At the same time, businesses might not be just willing to share data via such a system, but they need to be assured that they can exercise rights concerning their data and parts of the system. This is dependent on the same technological design choices.

At the same time this also opens new challenges as it shows that even in a simple case, a great deal of complexity can be present to analyze the full process. In the international trade domain, the reality is often more complex. Several carriers may be involved for the full journey and two different (subsidiaries of) competing carriers may cover parts of the journey and goods may change ownership during transport. The cargo in the container in our case is destined for one importer but in practice it is often destined for different

importers, requiring not only container but also item-level tracking. This increases the technological complexity for controlling and getting the visibility on the information for one shipment to create value for governmental organizations. Furthermore, the required data may be distributed among multiple blockchain platforms.

In the case of different carriers, they can hold their data on different channels in the TradeLens platform, but the carriers may also use different blockchain platforms (e.g. one carrier using TradeLens and the other carrier using an alternative blockchain platform, such as the pilot Global Shipping Business Network (GSBN) led by COSCO). Furthermore, the TradeLens platform is currently supporting track and trace functionality at container level tracking. However, for compliance monitoring, e.g., circular economy and sustainability where customs obtain increasing responsibilities, item-level tracking is required. Platforms such as FoodTrust[6] can provide such item-level tracking. This means that information about the same shipment that can be of value for government can be dispersed among different blockchain platforms, which requires combining data from multiple blockchain-enabled platforms. Therefore, while our case shows that the underlying technology matters for creating the value of the business data, understanding this technical complexity becomes even more important to unravel the value of information about the same commercial transaction that is spread among multiple blockchain platforms. This raises questions on how to understand the underlying technical design choices embedded in these platforms, and questions about the interoperability of these blockchain platforms. The framework for business-government information sharing that we used supports unravelling this technical complexity and encourages stakeholders involved to reflect on value in relation to the technical design choices.

Furthermore, the question of blockchain interoperability is often mentioned but is still a hypothetical question, as in practice the urgency for achieving interoperability among blockchain platforms has not yet materialized. In the international trade domain with the growing volumes of trade and the need for visibility this urgency for interoperability is already present: tthe interoperability of blockchain platforms is becoming a pressing challenge.

The view on the technical complexity, especially when more blockchain platforms are involved in the process of voluntary sharing, opens further governance questions on how governments need to connect to these multiple blockchain infrastructures. Would government opt for directly connecting to a multiplicity of blockchain-enabled platforms developed by businesses with all the inherited complexity to be able to understand how these underlying platforms are designed? Or would it require that businesses that are willing to share data with government, need to connect via government blockchain infrastructures such as the European Blockchain Services Infrastructure (EBSI) currently developed in the EU? All these questions open opportunities for further research on voluntary business-government information sharing to create public value enabled by blockchain-based platforms.

[6]https://www.ibm.com/blockchain/solutions/food-trust

6 CONCLUSIONS

The contribution of this study is two-fold. From an empirical perspective, our study goes a step further than empirical studies that examine pilot projects or blockchain implementations in government at the national level. We contribute to the eGovernment literature by providing empirical insights using an operational and global blockchain-enabled infrastructure and show how governments can make use of an operational global blockchain infrastructure (TradeLens) to create value. From a theoretical perspective, our study combines two frameworks that have been developed independently, namely (a) the framework for understanding public value by focusing on voluntary business-government information sharing, and (b) the blockchain governance framework, which allows to reason about the stakeholders' interests and the blockchain technical design choices. Our study combines elements of these two frameworks to arrive at a novel framework that allows examining relationships between blockchain technological design choices and value creation from voluntary business-government data sharing through such blockchain-enabled infrastructures.

Our case study suggests that in international trade, issues such as immutability and audit trail of data may be more important features for value creation than a high degree of decentralization which is normally considered as the main characteristic of blockchain-based platforms and applications. Our study further shows that even in simple cases, like the one that we analyzed, making the technology design options explicit is instrumental to understand how voluntary information sharing can create public value. In our discussion, we reflected on more complex cases which involve interoperability of blockchains that may provoke governance questions on whether and how governments need to engage with individual trade infrastructures for data sharing arrangements or use meta-blockchain infrastructures (e.g. EBSI that is currently developed in Europe). To this end, the framework that we provide which links voluntary information sharing to create value with blockchain technological design choices may be used in further research for analyzing more complex cases as well.

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