The Blockchain Potential for Port Logistics

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Abstract

The goal of this paper is to provide clear insight into how blockchain technology could contribute to the improvement of port logistics and the development of the digital port. In its capacity as a peer-2-peer distributed database, blockchain technology could add value in terms of trust, network expansion, visibility and more. Data is easily accessible whilst its safety is still guaranteed. This is because the partners involved in the network validate the data.

Currently, the technology is mostly in the single-use application stage. Blockchain technology is mainly used in niche markets at this point although more advanced applications are under development. The future of the blockchain will be determined by further research and a better understanding of the technology as well as the ability of society and the sector to adopt.

Samenvatting

Dit onderzoek evalueert hoe blockchain technologie kan bijdragen aan het verbeteren van havenlogistiek en de ontwikkeling van de digitale haven. Blockchain technologie draagt bij aan de betrouwbaarheid van informatie binnen een dergelijk netwerk, uitbreiding van een bestaand netwerk, keten transparantie en meer. Het is een terwijl de veiligheid van deze data gewaarborgd blijft. Dit gebeurt doordat betrokken partners in het netwerk de data valideren.

Momenteel bevindt de technologie zich grotendeels in de zogenoemde “single use application” fase. Toepassingen van de blockchain technologie liggen nog voornamelijk in niche-markten, echter zijn meer geavanceerdere toepassingen in ontwikkeling. Zowel verder onderzoek en een beter begrip van de technologie, alsmede het aanpassingsvermogen van de samenleving en sector, zullen de toekomst van de blockchain bepalen.

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1. Why are we talking about blockchain?

We live in a world which has an ever-growing need for improved efficiency. Supply chain management and logistics in particular require a secure and reliable flow of goods; this which must be achieved in combination with faster, cheaper and more efficient processes. One of the most important ways to attain such efficiency is by capturing and sharing *data*. For logistics, this means that there is real-time access, reliability, visibility and integration of relevant data in order to allow for the right processes to happen at the right time. Especially in the port, where cargo makes a switch between different transport modes and routes, such data is of tremendous importance. In an optimal situation, all information that both leads cargo to its destination and monitors it is available and accessible to all relevant parties in an online environment, creating a so-called *digitalized port*. On the topic of data sharing and the creation of a digital port, Ronald Paul, COO of the Port of Rotterdam Authority, states that digitalization should be embraced, as it is a prerequisite for advanced logistics[1].

What if we were able to create such a digitalized port in the coming decades? The Port Community System is a major step towards digitalization, but it might be in need of an upgrade. Some port processes are still very old compared to those in other sectors. There is redundancy of information regarding transactions and current processes are sometimes inefficient, still requiring phone calls and paper documentation.

Blockchain technology is definitely one of the most discussed topics in 2017 and could tremendously influence future port logistics and the digitalization of the port of Rotterdam. Some describe the technology as a simple distributed database which is hyped up by the developing organizations, while others identify blockchain as the digital revolution that will lead to social and economic changes.

The potential of blockchain technology lies in exploiting and extending networks. The technology can connect parties that were not previously connected, enable new forms of collaboration and create new business opportunities. In port logistics, blockchain has the potential to transform and disrupt port processes by documenting, validating and securing each event in the chain. Promising applications of blockchain already exist in port logistics and many other applications and business models will emerge as the technology matures; a similar development occurred following the initial introduction of the internet. Trade finance, product traceability and process automatization through smart contracts represent some of the most promising blockchain implementations for supply chains. However, these applications need different enabling conditions in terms of large-scale implementation by market parties and the time-frame for this implementation is also expected to differ from case to case.
This research aims to de-hype the technology and evaluate its real potential with regard to port logistics. It tries to provide an overview of the current implementations and the future deployment of blockchain technology. First, we would however like to offer a brief (technical) introduction to blockchain technology in the next chapter.

(Note: at the beginning of each chapter, text blocks containing key terms have been added.)

[1] Paul (2014). Column. Available via https://www.portofrotterdam.com/en/news-and-press-releases/without-data-no-logistics

2. What is blockchain?

Blockchain

INFORMATION TECHNOLOGY
PROCESS DATA SHARING
TRUST BUILT ON CONCENSUS
SECURED AGAINST FRAUD
DATA TIMESTAMP

A blockchain is a database for storing transactions that is shared among all the parties in a network. It serves as an (encrypted) ledger for information. The peer-2-peer network uses a consensus mechanism, which ensures that the transaction is valid before it is recorded to the ledger. A party must validate a transaction by providing the same hash as the other parties in the network. This hash is a specific and unique code that describes a message with information. The validated information is recorded on a block. A block can be compared to a container; everyone can see it from the outside, but only those with permission, *a private key*, can access the content. Next, each additional block is chronologically linked to the previous one, making it (almost) impossible to alter data that has already been recorded. The blockchain can be designed to be either public or private. This determines who can access the network and make or receive transactions. In a private network, there is an authority that sets the rules and gives out permissions. In contrast, a public network is open and the rules are consensus-based. In a blockchain system, there is no single owner of the data: everyone who has access to the data is an owner.

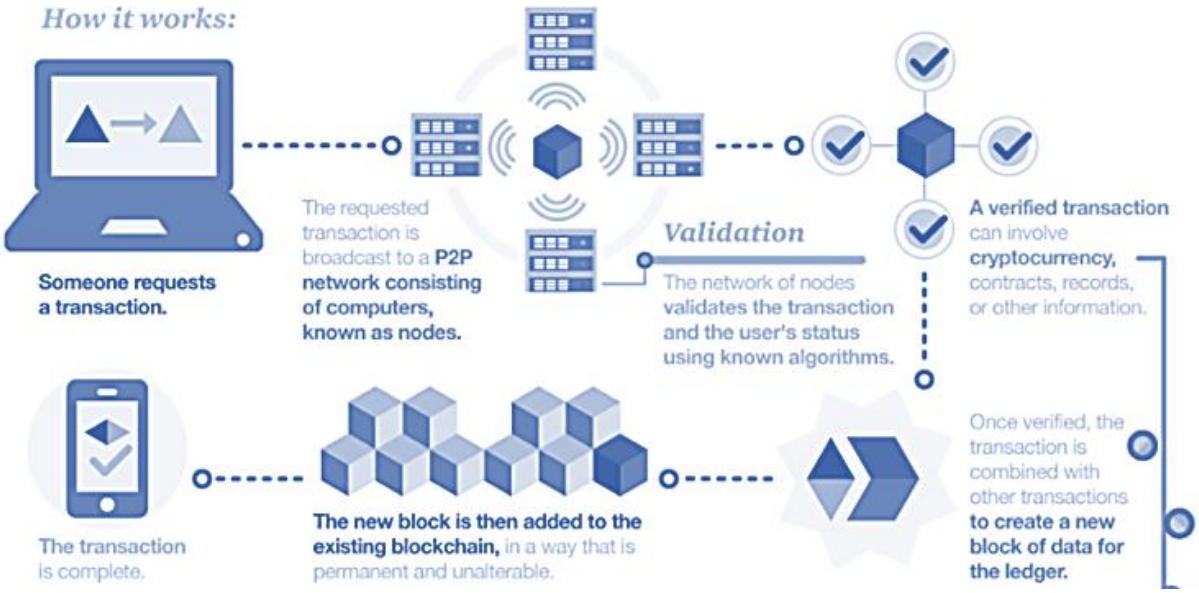

Figure 1. Blockchain explained (source: PWC[2]).

[2] Making sense of Bitcoin, cryptocurrency, and Blockchain, 2017. Available at http://www.pwc.com/us/en/financial-services/fintech/bitcoin-blockchain-cryptocurrency.html

3. How can blockchain add value to the port?

Through its typical features, the blockchain can add value to port logistics and port digitalization in a number of ways. These are related to *building trust*, *provision of secure data*, *visibility*, *network expansion* and *integration of supply flows*.

Blockchain makes the port smarter

TRUST BETWEEN PARTIES
HIGHER CONTAINER THROUGHPUT
NETWORK SECURITY
TRANSACTION AUTOMATIZATION
CONTAINER TRACKING/TRACING

3.1 Trust

Because blockchain is based on shared consensus among different parties, the information on the blockchain is reliable. Over time, partners build up a reputation on the blockchain which demonstrates their credibility to one another. Furthermore, because trust can be established by the blockchain network, a third party that arranges trade between two partners will no longer be necessary. In order to establish sufficient trust to become involved in a blockchain network, the motives and goals of the involved parties must be clear. The reputation of the participating organizations is now transparent and grows over time. In the port, it is important that companies in the chain can trust each other in order to share information and increase efficiency in shared processes.

3.2 Security

The validity of the information stored on the blockchain is ensured by an encryption mechanism. This provides a solution for the complex process of writing information to and validating information on the ledger. The complex mechanism not only ensures the validity of the information, but also prevents fraud. In practice, after six blocks have been added onto each other, changing the information stored on the block becomes highly unlikely.

3.3 Visibility

Introducing blockchain technology will increase visibility in the supply chain. For port logistics, this could mean that certain containers or products can easily be tracked and traced. Furthermore, enhanced visibility could also facilitate the exchange of information between different organizations. Through data sharing, critical information about the movement of containers throughout the port could improve port logistics. Real-time accessibility to each other's information will speed up payments and the movement of containers. For example, a container can currently only be released when the invoice of the container has been paid and a confirmation of the payment has been sent. In other words, the process steps are not connected across parties and most of the transactions require manual human intervention. With blockchain solutions, data is shared the moment the container is unloaded. The payment can be made and confirmed almost instantly, after which the container can be released. The process would take only a few minutes instead of days.

3.4 Network Expansion

Another way that blockchain adds value to port logistics and digitalization is the manner in which it stimulates network expansion and interconnectivity. The companies in the port of

Rotterdam are connected to each other via Portbase right now, but with blockchain new possibilities for growth could materialize. In the case of a public and open blockchain solution, the network would become decentralized and the parties would be able to connect individually and not just via a centralized party. Furthermore, different blockchain networks could interact with each other around the world, allowing different ports opportunities to work together in a unique way.

3.5 Integration of supply chain flows

Blockchain technology can enable a better integration of supply chain flows (physical, financial and information flows). To move the physical flow of goods through the port, for example when unloading a container of its cargo, it is necessary for the various parties involved to share certain information. Some examples here are trade finance, information required by Customs and every piece of information required by a party to perform consecutive tasks. Integrating these flows could give the port a new competitive advantage in the continuously changing supply chain environment. Moreover, new long-term contracts could be established with customers.

When to use Blockchain?

Blockchain is definitely a crucial invention, but it is important to understand that it is not a solution to everything. There are many cases in which blockchain is not applicable and could even harm business. Based on the above-mentioned value-adding activities, the following can be stated:

"Blockchain should only be used if a large number of people are involved, if there is a limited amount of trust between them, but there are clear incentives to work together, and if data needs to be immutable. Blockchain can cope with high coordination and establishes trust between parties. However, it requires a clear incentive and if it does not actually add value, then it could be a great waste of time and energy to invest in it."

It is of importance to carefully analyze where and how blockchain technology would add value before deciding to invest in it. For example, if a company only wants to share data between colleagues, a normal database would suit the company's needs just as well. Moreover, although the term blockchain is broadly used, there are different types of structures that may be implemented. In addition to the blockchain we have described earlier, which is a so-called *permissionless* blockchain, one may also opt for a *permissioned* structure (also called private or closed blockchain, as opposed to an open blockchain). Here, a central authority holds the administrative rights and options for user authorization. It takes away transparency and does not rely on the network effect, but may hold several benefits. When the data being transferred is highly confidential or involves business secrets, having a central authority that monitors the access to the blockchain and how it is used might be preferred

The aforementioned different ways to add value come together and lead to faster, cheaper

and more efficient processes in port logistics. Furthermore, some could even contribute to a digital port. But how can you define a digital port and what does it take to achieve this?

4. Where will blockchain technology take us?

Based on Gartner's hype cycle[3], the technology adoption curve and other frameworks of adoption, an estimation of the physical roll-out of blockchain technology in the (near) future can be made. Gartner's hype cycle demonstrates the typical progression of an emerging technology from over-enthusiasm, through a period of disillusionment, towards an understanding of the technology's relevance and role in a market or domain. Once the latter stage has arrived, we see that the general adoption and performance of the technology commences. At that moment, the adoption curve starts. Along this curve, so-called early adopters, early majority, late majority and laggards can be distinguished. The early and late majority are necessary to commercialize the technology on a large scale.

In a recent article in the Harvard Business Review[4], a framework for the adoption of blockchain was presented. Based on the novelty – the degree to which a possible application is new to the world – and the complexity – the level of ecosystem coordination involved – of the technology, four phases are outlined: *single use*, *localization*, *substitution*, and *transformation*. In the (1) single use phase, we find low-complexity and low-novelty applications of the technology that create more efficient solutions to current processes. In the (2) localization phase, only a limited number of users are necessary to create immediate value, yet the application is high in novelty. Once the technology moves to (3) substitution, applications are low in novelty as they build on existing single-use and localized applications, yet they involve an increasing and broader public use as more people adopt the technology. The (4) last stage (transformation) is reached when applications change the very nature of economic, social and political systems. The activities of all the actors must be coordinated, requiring institutional agreements on standards and processes.

In order to demonstrate this in practice, the development of RFID can be used as an example. The technology behind RFID has already existed for quite some time. Initially, RFID was only used in electronic surveillance tags in retail shops (single use). The technology gradually developed over time and new applications were tested. One example of this was a system to securely and safely track the transportation of nuclear materials (localization). Afterwards, investments in large-scale commercialization were made in order to implement the technology in different supply chains (towards substitution). However, a main drawback for general application was a lack of standards. It would not be until around 2005, when Wal-Mart required its top 100 suppliers to apply RFID labels to all shipments, that people started to take the potential of RFID seriously. The current technology however is still too expensive for successful large-scale implementation, so the application of RFID technology finds itself in between the localization and substitution phase.

[3] Gartner (2003). Understanding Gartner's Hype Cycles. Available via http://www.bus.umich.edu/KresgePublic/Journals/Gartner/research/115200/115274/115274.pdf
[4] Iansiti, M., & Lakhani, K. R. (2017). The truth about blockchain. *Harvard Business Review*. Available via https://hbr.org/2017/01/the-truth-about-blockchain

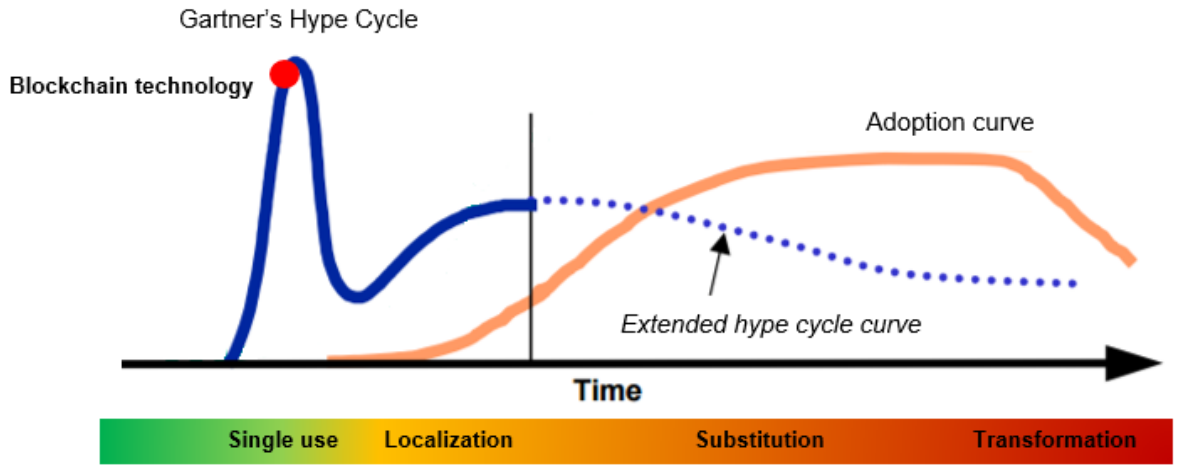

Figure 2. Technology lifecycle models and the adoption of blockchain, adapted from Gartner (2003) and HBR (2017).

What we see is that these frameworks and cycles can be combined in a new framework to assess the future development, implementation and performance of blockchain (figure 2). Projecting these to the current situation regarding blockchain, we see that blockchain is only at the very beginning. It is almost (or already) at the peak of the hype cycle, being heralded as the next paradigm shift in networks, changing the way we interact forever. Large companies are carrying out pilot projects, testing and improving the technology's performance as we speak. Adoption is slowly starting among players in the supply chain, but on a very small scale and mostly as an add-on to existing technologies. When specifically looking to port logistics, we find a range of such applications (Chapter 6).

Based on the presented framework, it is predicted that the hype around blockchain will sharply drop in the near future. Organizations will realize that blockchain is not the ultimate solution to all current problems and R&D efforts may decrease. Instead, the technology will find its place among existing systems, for example by add-on applications that enhance efficiency. It is next predicted that before 2020 these small applications will advance, marking the arrival of the localization phase. In this phase, the performance of the technology will go up. A phase of transition will occur in which hybrids of current IT systems combined with blockchain applications will most probably arise. It may take more than a decade for the technology to move on from this phase. In order to do so, the rate of adoption must increase. The strength of blockchain very much relates to the ecosystem that evolves around it. The technology brings forth a shift from technical infrastructure to ecosystem-enabling platforms. To fully benefit from this - and to enable it to substitute existing practices - a large and broad network of users is necessary. This is predicted to happen before 2030. Following the network effect, which is the phenomenon whereby a good or service becomes more valuable when more people use it, the technology may then eventually evolve from substitution to transformation of the current system. This could again take more than a decade, and whether or not blockchain technology will even arrive at this phase is a question that currently remains unanswered. It should be noted though that there are many possible scenarios for the implementation of blockchain, taking into account the general development of blockchain as well as current port logistics.

5. How could blockchain be implemented?

In order to demonstrate the possibilities of blockchain in port logistics, a few practical applications are described below and compared to the current situation.

1) Current situation:

When a carrier enters the port of Rotterdam, the cargo documentation is generally handled by the ship agent and sent to the Port Community System (PCS). The PCS enables the information distribution among the parties in the network to facilitate the container movement throughout the process. However, the process steps are not systemically connected across parties and not all the parties involved are included in the network (insurance companies, banks). This process breakdown sums up the inefficient means of communication, leaving room for improvements that Blockchain can fulfil.

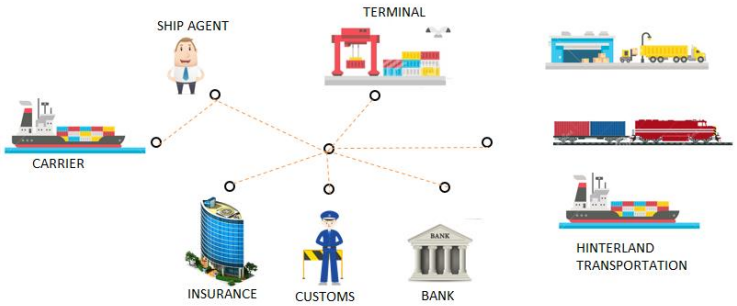

Figure 3: Current information flow in the import carrier process.

2) Blockchain as a means to store information:

The implementation of a blockchain platform may facilitate the exchange of information among the parties involved in the process. This can be achieved by storing the cargo information on the ledger. Instead of exchanging documentation, the parties involved in the process are granted permission to access the block where the information is stored. This leads to the creation of a unique, shared piece of information which can be accessed in real-time and with lower transaction costs. The process can be further accelerated by including parties that are currently external to the process (banks, insurance companies).

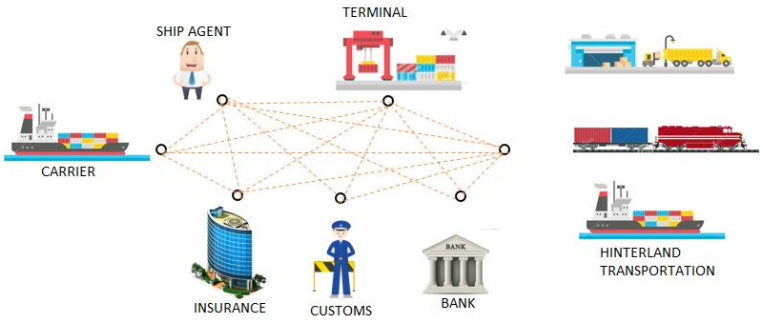

Figure 4: Blockchain information flow in the import carrier process.

3) Blockchain applications:

The database can be further improved by implementing *Internet of Things* (IoT) devices and connecting them as blockchain nodes. For instance, trackers can be mounted on containers so that smart devices can automatically record information on the blockchain without any user input. Moreover, sensors installed in the container can monitor the status of goods, providing information to the insurance company. Furthermore, by linking smart devices with *smart contracts*, it is also possible to fully automatize the process (Figure 5).

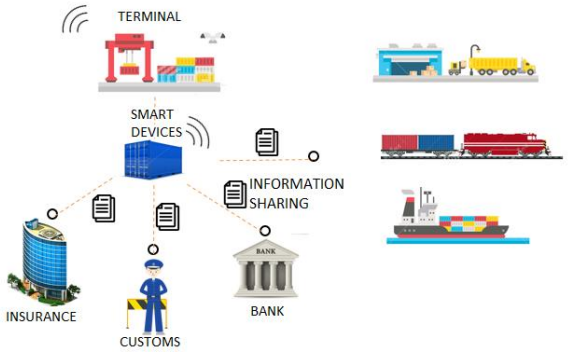

Figure 5: Import carrier process with IoT, smart contracts and blockchain.

Automated processes could, for example, be in the form of *Supply Chain Finance* (SCF). In this case, smart contracts will decide which transactions will happen at what time. In SCF, the financial institution is connected to the supply chain parties and can approve payments as soon as a certain action takes place and is recorded onto the blockchain. Usually, a buyer of a product waits for as long as possible to pay the supplier in order to improve its own working capital. SCF however means the supplier is now able to access the invoice they sent to the buyer. The supplier can submit it to the bank the moment it is approved, which is as soon as the blockchain system is notified of the arrival of the product at the buyer. This way, the supplier receives its money much sooner (about three months) while the buyer benefits from a long-term relationship in addition to discounts due to immediate payment. The bank is paid a small fee, leaving both the supplier and the buyer to benefit from the situation.

Another implementation-related example relates to the *circular economy*. Visibility and traceability of the whole supply chain could in the future enable a circular economy, where each product is recycled and sold again over and over. In order for this to happen, each product must be split into degradable components that can be recycled. Access on how the product is composed is crucial for this. Since a lot of companies prefer not to share this information for fear of potentially losing a competitive advantage, a system should be in place that makes sure the information is not leaked. Blockchain would constitute a solution whereby information would only be shared if it is necessary for the process and only with the right people. Moreover, blockchain could solve the problem of forecasting the used-products return flow. Based on the concept of traceability, the company implementing a circular economy can forecast the quantity and provenance of returned products.

6. Current market applications

Several blockchain applications for the logistics sector are already on the market and some of them are described in Table 1. These applications can be categorized based on the functionalities provided and the market size that they address. Some of the major functionalities addressed are: Trade Finance (Skuchain), Traceability (Provenance), Invoicing (Tallysticks, Fluent), Internet of Things (Chain of Things) and Goods documentation (SolasVGM, Wave). Before further describing the current applications, it is necessary to differentiate blockchain "platforms" from blockchain "applications". The term "platform" is used to identify the infrastructure that works as a technical backbone for several applications. Platforms are meant for large-scale implementations of the technology. Examples of platforms are the IBM Hyperledger and the TU Delft Trustchain. Applications on the other hand are niche implementations of the technology which are limited to the fulfilment of a specific need (invoicing, trade finance optimization, etc.). Examples of applications are Wave, Tallysticks, Skuchain, Fluent, Provenance and Chain of Things.

First, we will provide a description of the current market applications (table 1). Second, we will categorize the market applications based on the HBR model (2017) (figure 6).

Table 1:Market applications in logistics.

Name	Brief explanation
Wave	Financed by Barclay's Accelerator, this blockchain application aims to eradicate the Bill of Lading. It connects the manufacturer and the purchasing company by building a blockchain application where the parties involved in the supply chain gain access to the information on shipments. This application is targeted at the parties making use of the bill of lading documentation.
Skuchain	Developed in collaboration with a consortium of international banks, Skuchain aims to eradicate the use of Letters of Credit (LC) and create a new era of collaborative commerce based on an enhanced trust mechanism. This application is targeted at the companies handling the cargo paper documentation: buyers, sellers, logistics service providers, banks, Customs and third parties.
Provenance	This supply chain solution provides physical products with a seamless digital 'passport' that ensures transparency and trust. This will prevent the selling of stolen or fake goods by having an auditable account of the journey for all physical products. The target group of this blockchain solution is the final customer, but it has a strong impact on the whole product supply chain as well.

Tallysticks	A distributed ledger application to make invoicing, invoice financing and invoice securitization more seamless and efficient. Making use of smart contracts, the technology enables the auto-reconciliation of payments to corresponding invoices. Moreover, it leads to the increase of transaction transparency, preventing fraud and errors.
Fluent	This blockchain application enables fast, low-cost, simple and secure invoicing and payment systems for the global supply chain. The target group is banks, financial institutions and globally operating companies.
Chain of Things	A blockchain application that enables the use of IoT to solve insurance and trade finance issues. It develops sensors for the monitoring and recording on blockchain of data on the goods.
Hyperledger	This is a blockchain platform developed by IBM with potential applications in the supply chain and several other industries. It represents an open standard for distributed ledgers that can transform the way business transactions are conducted globally. It enables several applications to be built on the protocol.
SolasVGM	A blockchain-based application that creates a collaborative ecosystem between all landside parties, load point, shipper, driver, booking party, terminal and shipping line. The application gives parties involved in the supply chain access to the cargo's Verified Gross Mass (VGM).
TU Delft Blockchain Lab	TU Delft is developing a blockchain platform that addresses the technology's issues of scalability and transaction speed. This architecture is based on an advanced mechanism of trust and cryptography. It has been tested in three pilots.

Some of the above-mentioned market applications aim to fully eradicate current logistics procedures, such as the Bill of Lading and the Letter of Credit, rather than simply substitute them in a digitalized version. This substitution of current practices may encounter obstacles in terms of legislation, governance and adoption as discussed in Chapter 7.

Figure 6:Market applications analyzed with the HBR framework (2017).

7. Are there issues for implementation?

Before the current application of blockchain technology can be developed towards a more advanced state and broader use, there are several concerns that must be addressed. These are mostly related to the transformation that needs to take place in the business sector and the change in mindset that needs to occur. The following main concerns can be outlined: *difficulty of adoption*, *lack of trust*, *need for governance* and *legal issues*.

7.1 Difficulty of adoption

The difficulty of adoption can be split into technical and functional concerns. Experts in the field of blockchain technology foresee a continuous process of trial and error of single-use applications that will lead to uncertainty among companies to invest. First, single-use applications will be developed. Over time, the paradigm shift of innovation will occur; a radical innovation, in the form of a single-use application or an extended version of a single-use application, will replace obsolete applications. However, more computing power is required to implement the blockchain technology on a very large scale. Currently, companies want to invest in the blockchain due to the huge hype. In some cases, alternative and simpler technologies will however be more feasible and appropriate.
Second, the viability of the investment could be questioned, addressing the functional difficulties of adoption. The companies operating in the port of Rotterdam are very diversified in terms of size, operational level and the availability of resources. Currently, only several larger firms seem to be experimenting with the blockchain technology. Eventually, they will create a platform to which SMEs could also link. SMEs however might be reluctant to participate in the platforms of these large players. Also, since the databases of the different companies may use different standards or languages to store data, interaction may prove difficult. Addressing this would require resources and time to align databases or invest in a shared language for the blockchain.

7.2 Lack of trust

In a nutshell, implementing blockchain technology raises questions concerning the reliability of data provided by the suppliers and customers: is the data provided by the supply chain partners reliable? A second concern to migrate data systems would be the resistance to share information with supply chain partners. Firms are not likely to share critical data that could potentially make them more vulnerable. To solve this issue, neutral intermediaries (Port Community Systems) have been established in the past. A blockchain configuration changes this perspective since the technology itself works as a guarantee of trust among the parties in the process. However, are the companies in the port area ready to shift their trust from a company to a technology?

7.3 Need for governance

Once more participants are connected, questions about the governance of the system will arise, such as who is authorized to access data (accessibility) and who owns the data (ownership) shared in the blockchain. Moreover, in the case of a private blockchain solution,

there is the question of who the neutral party in charge of setting the network rules and granting access permission is.

7.4 Legal issues

No clear regulations are yet in force in this area (need for regulation), since the blockchain is still an emerging technology: what regulation needs to be developed to implement the blockchain solution? Agreements between countries within and outside the EU must jointly address regulations concerning the systems.

8. Conclusion and recommendations

This paper endeavors to evaluate the blockchain potential for the improvement of port logistics and the development of the digital port. Our conclusion is that blockchain technology is a promising development that can support both the digitalization of the port and enhance the efficiency of current supply chain processes. However, a number of questions and general concerns became apparent during our research; these will need to be addressed before any type of blockchain architecture can be implemented on a large scale. First, port logistics companies must clearly understand the benefits of blockchain technology and determine whether it is really necessary for them to have a database based on blockchain principles. Second, a blockchain IT system should be fully understood: what are the pros and cons of such a system? It is important to consider alternative IT systems as well. Once the decision has been made to invest in blockchain technology, operating a blockchain on a low complexity level is preferred; single-use applications are more likely to be implemented successfully. Further extensions could be developed afterwards to increase the network size and complexity.

It is expected that this will not pose any limitations to the future development of the technology. Rather, the largest difficulty lies in transforming the current business landscape. The mindset of the current players in the port must change before blockchain technology can be successfully implemented. Change could be met with resistance and it is important to make sure everyone is on the same page. One of the key issues associated with the blockchain is trust. It is essential that the partners in question are able to rely on the data that is provided by the system. The reputation of the parties providing the data plays a large role here. Perhaps, institutions could award certificates to companies, similar to ISO certificates or certificates that guarantee a certain origin, such as a “fair trade” label. Data sharing should be considered an opportunity instead of a threat. This change in mindset would allow a single organization to benefit from an amount of data that is larger than the amount of data it has provided to the system itself. Moreover, inconsistency due to misaligned systems can be avoided by migrating different systems into one: the blockchain.

Here, the role of the port authorities becomes important. In the near future, they can take on the role as facilitator and booster of a specific network. They can bring together stakeholders and convince them whilst at the same time addressing the aforementioned concerns. In order to play an important role in the digital port of the future, they may start by developing standards for such a port. Also, they could take on a managerial and coordinating role and manage access as well as integration of different blockchain applications. By staying on top of the

developments and providing a transition path for companies, they will be able to ensure a role in the digital future of the port.

Right now, a few projects are underway in which blockchain applications are being tested for future implementations. A great project which involves as many as 16 partners, including ABN-AMRO, TU Delft and the Port of Rotterdam Authority, is the TKI Dinalog project[5]. This Dutch project is currently testing three user cases: supply chain finance, inventory finance and a circular economy. Another interesting project of the TU Delft University is called the "blockchain lab"[6]. Here, professors and PhD students are conducting experiments with blockchain with the goal to reinvent money.

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[6] Blockchain Lab (2017). Available via http://www.blockchain-lab.org/#about