The impact of blockchain technology on the supply chain collaboration

The implementation process and effects on trust issues between

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Nowadays daily business activities are performed all around the world, connecting entities without geographic boundaries. It is the nature of a coalition that a relationship often suffers from trust issues which can represent a harming factor on the overall performance in the supply chain. Due to this circumstance technology plays an occurring role in the business world, raising the question on how to gain advantage out of the transcontinental business relations. The additional concern of digital disruption in the last years generated more attention for blockchain technology from professionals. Nonetheless, whenever blockchain is mentioned, people tend to think in first line about cryptocurrency, also referring to Bitcoin. But blockchain technology has much more to offer than only financial applications. In that respect, this technological solution has the ability to connect people, guaranteeing a save and transparent data exchange by reducing the possibilities of fraud.

Consequently, the study analyzes the impacts of blockchain on the supply chain collaboration between business partners, trying to answer the question why companies actually feel the necessity and need to adopt blockchain and make their processes more transparent. Further, the focus of this study lays on the matter how blockchain can decrease trust issues as well as the implementation process and potential pitfalls.

Keywords: Blockchain Technology, Supply Chain, Collaboration, Trust, Transparency, Information Sharing

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1. Introduction

1.1. Background

Supply Chain (SC), in other words value chain or demand chain, is a main pillar in the daily activities of a business. It is building a network between different firms with the purpose of transforming material, based on the customer's demand (Davis, 1993). Therefore, each stage in the SC helps adding value to a product, service or information until its final version is delivered to the end user (Lambert, et al., 2006) (New & Payne, 1995). As Supply Chain Management (SCM) has an important role in a corporate's daily operations, it is crucial for a company to gain competitiveness through strategic optimization, especially regarding the improvement of the relationships in between the supply chain network with different entities (Lambert, 2008). This SCM has to cover a various number of tasks during a long-term partnership inter alia coordinating the flow of materials across multiple channels (Stevens, 1989) and having shared access to demand and sales data with the network partners (La Londe & Master, 1994).

More precisely, SCM can be divided into three main areas, namely the integration of all partners inside a supply chain, the redesigning of processes and finally the introduction of IT systems supporting the coordination and communication (Kuhn & Hellingrath, 2002). A well performed management can lead to a decrease in costs through an enhanced inventory model, improved quality, shorter overall lead time[1] as well as a more profitable positioning in the market (Monczka, et al., 1998).

In order to stay competitive, the Supply Chain Collaboration (SCC) builds an important part as its benefits are multiple-sided, affecting all parties in the SC and thus leading to a general advancement in the performance (Soosay & Hyland, 2015). However, a well operating collaboration between different parties in the supply chain is connected to mutual trust, sharing sensitive data and insights into financial information across firms as well as opening up operational plans (Min, et al., 2005).

A way to facilitate the collaborative nature between partners is the increase of transparency through blockchain which is in first line known for its financial application but only little for its effects on the supply chain (Francisco & Swanson, 2018). At large, blockchain offers

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[1] Lead time is the time needed for the completion of a process in which a raw material is converted into a product for the end consumer (Christopher, 2016).

in this context next to the transparency, also improvements in the tradability and traceability of assets (Song, et al., 2019).

1.2. Problem Statement

As mentioned beforehand, the SCM is depending on many critical factors including the SCC and its common planning, forecasting and replenishment (Barratt, 2004; Horvath, 2001). Therefore, it is crucial to note that in order to increase the business performance and to position the own company competitively in the market, the SC and consequently also the interaction with two or more external partners plays a significant role (Soosay & Hyland, 2015).

Having mutual trust as one key point in building a healthy relationship between partners, it is a long-term process to build a solid level, mostly through proving the loyalty and ability during daily business over time (Min, et al., 2005). Leaking trust, can lead to an increase in transactions costs, bad problem solving and decision making that causes an overall suffering in business performance (Sridharan & Simatupang, 2013).

In this regard, the need for facilitated trust building may arise to lower the risk of mismanagement regarding the SCC. This is where the technology takes over, more precisely the blockchain technology (BT). It is assumed that BT allows companies to reduce risk factors by increasing transparency with improved traceability, certifiability, trackability and verifiability, whilst making information exchange safer and more secure against fraud (Montecchi, et al., 2018). In addition, all information is stored equally accessible from each collaborating party.

Accordingly, this thesis does not put its focus on the traditional financial approach of BT, but on the adaption on SC in a further analysis, putting special emphasis on the questions:

- In which extend can blockchain technology influence the supply chain?
- How can blockchain technology reduce potential trust issues in the supply chain?
- What are possible challenges concerning the implementation process of blockchain technology?

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1.3. Methodological Approach

As the topic of this work is very recent and currently catching the interest of companies, this thesis is based on relevant literature combined with a qualitative empirical work. Especially for the fact that the chosen topic is a newly occurring one which is not far established in research yet, there is still a lack of data that could be represented on a quantitative scale. Therefore, a qualitative approach appears to be the most suitable solution as a quantitative work would not offer this study enough validity and reliability.

The literature review was built in form of "pearl growing". In the first steps, journals and books were read for the purpose of identifying significant authors and scientists who have a greater impact on the perception of SCM, SCC and BT. In further steps, the literature of those authors was studied for the purpose to ensure that other significant sources would be covered. This systematic literature searching can also be called "citation mining" or "snowballing".

The qualitative study is conducted in form of semi-structured interviews with three start-ups offering blockchain technology solutions to companies. More concretely, the participants were found through research in the internet, narrowing the BT down on specialization in supply chain. It was decided to not focus on one industry in detail, but to put different industries into consideration in order to get a broader understanding of the overall impact of BT.

1.4. Structure of Thesis

In the first parts, the topic is introduced, providing a basic understanding of what the study will be about by giving a first overview about supply chain, the supply chain collaboration and blockchain. Continuously, the problematic in modern supply chains is being emphasized, illustrating why this topic is of high importance and how the new technology can play a role in it. Therefore, relevant literature is presented, building the basis theory helping to explain the main concepts and their interactions. This is followed by an empirical part with the aim to gather information based on real-life experiences and to compare these findings in a final step with a purposeful sampling. Finally, the conclusion merges all results from the prior analysis illustrating to the reader possible limitations and future perspectives for research.

2. Basic Definitions and Concepts

2.1. Blockchain Technology

Blockchain is an emerging technology which is especially known for its application in form of Bitcoin (2008), but it offers many more possibilities. Especially its potential impacts on businesses' performance attracted more attention in 2013 (White, 2017). With the implementation of blockchain technology it is expected that the transparency and data security is increased, trust issues are reduced between partners on the blockchain and costs especially for third parties are resolved. Thus blockchain can affect businesses in many different areas, from the strategy over to the organizational structure, data and economic issues, or technological implications (Ølnes, et al., 2017).

Blockchain technology is a decentralized public ledger in a peer-to-peer network that can be distinguished into two kinds, the public and private one. First, can be accessed and used by everyone without restrictions, it has a decentralized character which means that no one has direct control over the technology. Whereby the second, also called a permissioned blockchain, has one or more controlling authorities giving permission to other parties to participate in the blockchain (Min, 2019). Next to the component of being a distributed public ledger, the blockchain is verified, immutable and features an asymmetric cryptography, a consensus mechanism and transactions[2] carrying the digital signature (Puthal, et al., 2018).

Elements that operate in the blockchain are nodes, miners, and blocks. Nodes are the connection points of participants in the network, easily said the computers or people. Miners are a certain type of nodes which carry out the verification process of a block through an agreement ("Consensus"), the calculation of the hash values and finally the creation of new blocks. (Karafiloski, 2017; Tama, et al., 2017) These blocks contain digital information about transactions, a timestamp, the own hash value as well as the one from the parent block[3], and the digital signatures of all participants in the transaction. Together they build a chain, in other words the database, consisting out of block headers and block bodies (Zheng, et al., 2017).

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[2] A transaction describes an exchange of value between partners in a network (Min, 2019)
[2] A parent block is referring to the immediate prior block, whereby a genesis block is the first block in a chain and is the only one not having a parent block (Zheng, et al., 2018)

Due to the cryptographic applications of blockchain users have the possibility to trust in the system without the necessity of a third party. Such an application is for instance the authentication of the identity next the previously mentioned digital signature and timestamp (Fang, et al., 2020). Cryptography aims to prevent private data visibility to external entities with the help of protocols[4] whilst leveraging the security, the integrity and decreasing the risk of fraud. On the one hand, the encryption transforms the plaintext into a secret code, more precisely a ciphertext, which is not readable for the outside. The decryption, on the other hand, allows the end user to convert the encrypted content back to its original format. For this en- and decryption, a symmetric or an asymmetric cryptography with public and private keys can be utilized. (Kessler, 1998).

2.1.1. Cryptographic Elements

The blockchain technology applies the asymmetric cryptography which is a newer method in contrast to the symmetric one and makes use of two different keys, the public and secret key. This leads to an increase of data security compared to the symmetric encryption. In this context, the public key can be given to any party in the network that wants to interact with the recipient, whereby the secret key is exclusively for the recipient and cannot be used by any other entity (Swan, 2015).

The digital signature helps in the process of authentication and identification of a document as well for the purpose of integrity and non-repudiation[5] (Liu, et al., 2017). This concept can be split into two parts, the signing, and the verification. The process of the digital signature starts by building a hash data which is encrypted by the private key of the sender, resulting in the digital signature. It is important to note that only the hash is encrypted but not the contained information of the message. After sending the data to the recipient the verification takes place, in which the receiver uses the sender's public key to decrypt the signature by making use of the hash algorithm (Zheng, et al., 2018). This decryption produces a hash signature that must be matched up with the sender's one. Either these values match each other, indicating that the content was not transformed after signing, or

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[4] A protocol refers to a set of algorithms (two or more) that transform an input into a corresponding output (Oppliger, 2011)
[5] "Non-repudiation means that participants cannot deny the transaction and behavior in the transaction of Ecommerce in the blockchain" (Fang, et al., 2020)

differ which may imply that sent data was modified or that the public and private key do not match (Swan, 2015).

After a transaction is certified by the business partners, it is sent into the peer-to-peer network in which nodes create a corresponding hash by running mathematically challenging tasks. The difficulty in the block mining process is to find the correct solution containing the hash value of the parent block as well as the own hash value or more specifically the Merkle root (Min, 2019; Eyal, et al., 2016). This specific form of a hash value is created when the blockchain technology applies the concept of the Merkle tree, developed in 1979, in the case that a block has multiple transactions. This model allows to reduce all individual hashes of the transactions within the block into one single hash value, the Merkle root (Berman, et al., 2007). In addition, the mining can endure around 10 minutes and is based on algorithms that can vary between blockchains. Once the created block is verified by the consensus nodes, it is linked to the chain (Baliga, 2017; Min, 2019; Nakamoto, 2019).

As the blocks are linked through the hash values with each other and contain a timestamp, they are chronologically ordered without the possibility of tampering or reversing data easily (Puthal, et al., 2018). In case that any modification has been done to the block, the hash value changes automatically as the block has to be "unchained" and once again verified by the nodes, resulting in an effective fraud detection as the hashes of the parent and child block would not match anymore (Nofer, et al., 2017). Especially the combination of hashing and the timestamp ensures the user transparency of made transactions (Swan, 2015).

Another application of the hash function is in the block header and represents a unique alphanumeric string in the blockchain for the purpose of identification, comparable to a "fingerprint" (Swan, 2015). The hash function has three possessions described as the pre-image resistance, that refers to the difficulty of changing a hash value back to its original content and making it more difficult for fraudsters to get access to information. The second pre-image resistance, that underlines the uniqueness of a hash, outlining the impossibility to find a second input with the same output. And finally, the collision resistance, that explains the difficulty of encountering two inputs with the same hashed output. The collision resistance implicates the second pre-image resistance, whereby the conjunction of the first two properties, the pre-image resistance and second pre-image resistance, form a one-way hash function (OWHF) (Rogaway & Shrimpton, 2004; Oppliger, 2011).
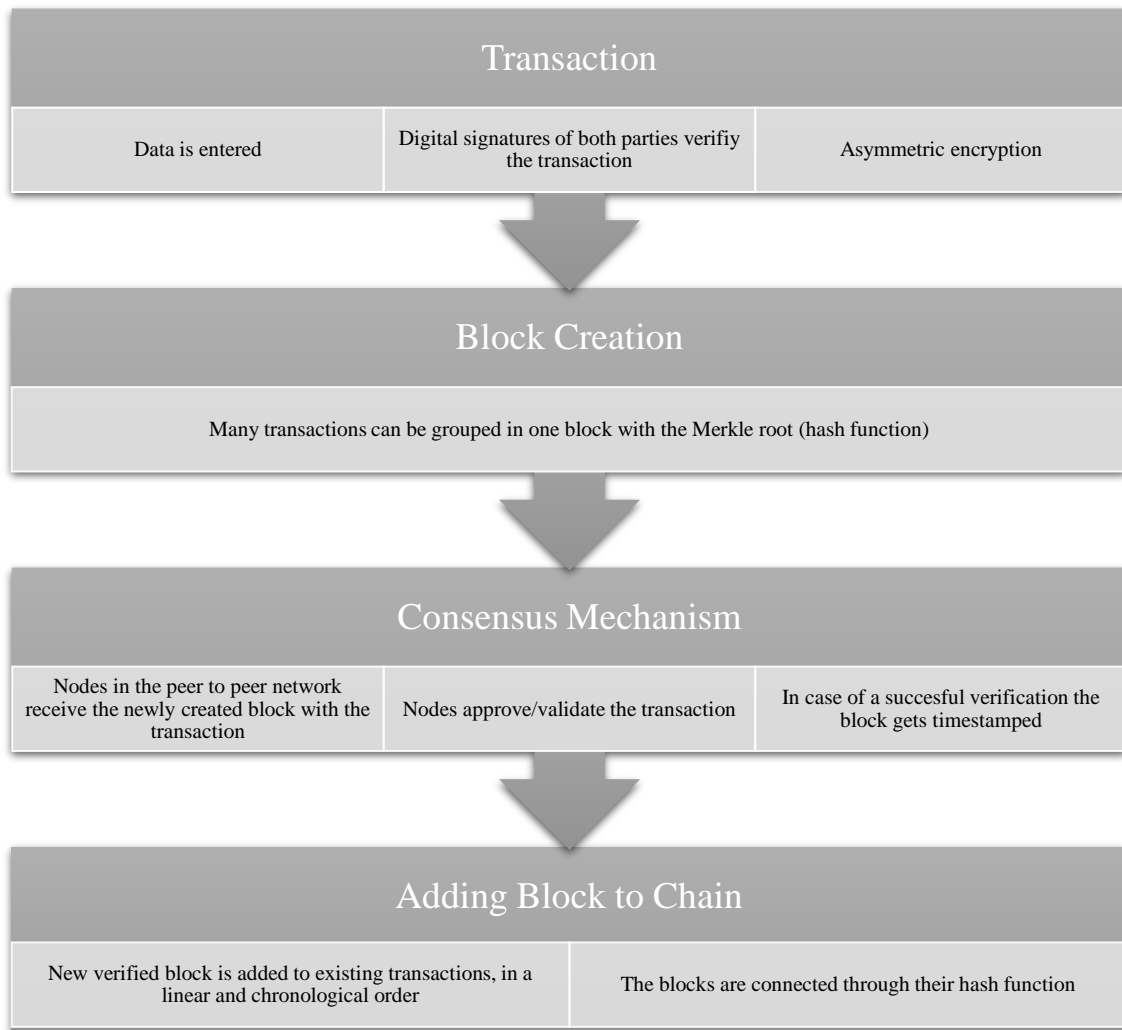
Figure 1: Transaction process in the blockchain

2.1.2. Areas of Application

At large, the blockchain applications are divided into financial and non-financial ones. Concerning the financial applications, experts speak about private securities and insurances. Securities can be applied on the stock market, in which users can facilitate transactions of shares immediately via the network without any involved third party controlling the exchanges (Crosby, et al., 2016). Obviously, the most famous financial application is crypto currency with the first known use case of Bitcoin that builds a digital money ecosystem. This new currency is fundamentally different from what people were used to as there are neither physical items involved nor any digital coins that would remind somebody of the traditional money (Antonopoulos, 2014). The second financial application can be observed in the insurance industry, that clarifies and stores information about the ownership of an asset, for example for real estate, automobile or digital gadgets (Crosby, et al., 2016).

In respect to the non-financial applications, they can even be further distinguished into social and legal (Abeyratne & Monfared, 2016). The social component comprises as an example the digital identity and the voting. For the digital identity, each user can employ the blockchain technology for proving one's identity with stored information about the driver's license, passports, or identity cards (IDs). Additionally, this application allows to speed up processes, and to experience an improvement in anonymity and security (Swan, 2015). Regarding the voting feature of a blockchain, the main goals are to enable access for everyone and to reduce fraud and cheating. To achieve this, the blockchain distributes for example one coin to each individual entity that is representing a voter. After having voted this coin is being transferred to the selected candidate's wallet. Consequently, the technology has the ability to ensure that all voters casted their vote only once (Kshetri & Voas, 2018). In legal terms, the decentralized technology can help regulating juridical issues such as in smart contracts or smart properties. Smart contracts are protocols that allow automated transactions without the involvement of third parties, these transactions refer to the exchanges of digital assets like payment terms or confidentiality. This process relies on a set of conditions which must be met from both involved parties in order to be validated (Abeyratne & Monfared, 2016; Fairfield, 2014). Lastly, the smart property has a close connection to the prior application as these possessions can be involved in the transactions of smart contracts. Speaking about those properties they can be tangible, like houses, cars, computers, or intangible in form of shares, copyrights or software (Swan, 2015).

2.2. Supply Chain

The supply chain includes many steps between the origin and the end consumer, not only implying the physical relocation of goods but also strategic skillsets. Especially the interdependency of the different steps in the supply chain can create a "domino effect" if one activity is miscarried. Not only would this harm the overall business performance but also the customer service. In order to decrease this possible risk, the supply chain has to be fully integrated and not seen as many different entities put together (Stevens, 1989).

The process of exchanging value between different entities underlies a network in which supply chain entities are linked to each other through their processes. One of the major activities in the supply chain that manages the business processes and network structure is

the supply chain management which at the same is closely related to the management of relations between different parties (Lambert, et al., 1998). A leading goal of having a smooth supply chain is the cost advantage and customer satisfaction, generated by supply and distribution. Therefore, supplier and customer relationships have to be continuously maintained in order to increase the received value for the clients and to be able to gain cost advantages against the competitors (Christopher, 2016). In addition, the supply chain management follows the ideology of creating benefit to every participant in the chain, especially through leveraging trust and communication between partners (Tan, 2001).

A key take away that is important for companies to understand is that their competitors are not directly other businesses but rather competing supply chains (Christopher, 2016).

2.2.1. Supply Chain Collaboration

The supply chain collaboration is reason for companies to exchange with other entities internal information, concerning operations and financials, as well as strategic data, following a mutual goal (Simatupang & Sridharan, 2002). In this context sources highlight the importance of trust and describes it as the "cornerstone" of a partnership (Kwon & Suh, 2005). The literature differs between multiple types of collaboration in the supply chain including the strategic alliances, joint ventures, cooperative arrangements, and virtual collaborations. Further it also mentions different possibilities of how to integrate businesses into the supply chain, namely vertically, horizontally, or laterally (Soosay, et al., 2008).

To begin with, the strategic alliances are often built for the purpose of knowledge transfer and sharing of technological resources. Particularly in innovation driven industries the alliances give the companies the possibility to spread the risk of innovation failure with the aim to increase the competitiveness of all partners in the alliance on a long-term perspective (Mowery, et al., 1996; Spekman & Sawheny, 1990). Secondly, the joint ventures are business coalitions in which two or more parties build an independent entity in order to share resources and enter a new market (Kogut, 1988). Oftentimes these ventures follow an exchange of strategy, resources, and financing for expertise and workforce (Collins & Doorley, 1991). Third, cooperative arrangements comprise the same goal set like strategic alliances, namely sharing resources and implementing new processes between partners (Soosay, et al., 2008). For these arrangements, the trust is increasingly a

driver that forces companies to select their partners wisely based on expertise and shared values. Literature mentions that flexibility and informality between firms are boosters for a positive relationship in these arrangements (Kumar, 1996). And lastly, virtual collaborations are as the name reveals associations in which entities are integrated on telecommunication technologies. Again, trust plays a major factor relying on fairness and a transparent environment between the entities. In contrast to the prior emphasized shared resources, in the virtual collaboration it is important that companies pay attention to their own abilities in order to be able to compete. In this regard enterprises should be aware about their own activities and abilities that are showing "natural tendencies", superiority towards competitors and potential market opportunities (Scholz, 2000; Soosay, et al., 2008).

According to the different kinds of integration, the horizontal one defines the inclusion of companies which are unrelated or even competitors and simultaneously are in the supply chain on the same hierarchical level and possibly manufacture similar products or pieces that complement each other (Soosay, et al., 2008). The vertical collaboration displays the integration across different areas in the supply chain, from the suppliers over to the distributors and customers (Barratt, 2004). Lastly, the lateral integration represents a mix out of both former mentioned forms (Simatupang & Sridharan, 2002).

For the purpose of benefiting the most from these collaborations, participants not only have to be aware about strategic elements but at the same time about the importance of cultural components, counting the exchange of information, mutuality, communication, long-term prospects and trust (Ellram & Edis, 1996). To begin with, the information flow stresses the transparency and information quality sent amongst associates. In this regard, the function of an involved intermediary party is assumed to cause unnecessary expenses as well as damaging the wanted transparency (Popp , 2000). Moreover, the mutuality explains the equality in a collaboration claiming for each party the same benefits and connected risks. In a next point the communication not only facilitates the information exchange but also helps enterprises to leverage the understanding for one another. Finally, trust is being highlighted by many authors to be an essential parameter in building a stable relationship and increasing the supply chain's effectiveness[6] (Heide & John, 1990; Barratt, 2004).

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[6] Effectiveness explains how far goals are fulfilled (Eisinger, 2002).

Besides the improved effectiveness of a business also efficiency and profitability can increase due to a well performing supply chain collaboration, for instance resulting in lowered inventories, cost advantages, minimized lead times as well as bigger market shares or more sales (Min, et al., 2005).

2.2.2. Occurring Challenges in the SCC

As the supply chain is highly important for a company's performance, understanding challenges and burdens is crucial. Even though that integrated IT systems are of high importance determining a collaboration's success, an exaggerated use of technologies in the first stages of a cooperation can be identified as reason for poor performance (Hudnurkar, et al., 2014). Even more critical are cultural elements that refer to the attitude and behavior of the entities towards each other (Barratt, 2004; Fawcett, et al., 2010). Further, the fear of failing or the possibility of exploitation by the associates can lead to the situation in which entities stop contributing to the collaboration in their full potential, restraining intangible and tangible assets as well as slowing down the information exchange. These problems are called the "hold-up" and "leakage" problem (McCarter & Northcraft, 2007). The result is a social dilemma in which an associate who betrays the partners can get a higher added value than the other parties, whereby at the same time the overall benefit is always greater when a harmonic collaboration exists. Consequently, the quandary is usually between personal gain and shared success (Zeng & Chen, 2003). Beyond that, for the purpose of running a harmonic supply chain relationship, further culture related inabilities like the lack of trust, the aversion to share sensitive data, prolonged payments or the involvement of third parties that control the documents regarding manipulations or errors between associates have to be solved to minimize disputes and charge backs (Fawcett, et al., 2010).

2.3. Integration of Blockchain in the Supply Chain Collaboration

Speaking about the application of blockchain in the supply chain collaboration, this technology allows to connect all entities that are involved in the supply chain process, counting from the manufacturer over to the retailer (Petersen, et al., 2018). The concern of privacy is the first instance to determine before implementing this technology into the

supply chain. In addition, many businesses pick the private supply chain in which only a particular selection of businesses has access to. Therefore the functionalities of blockchain allow the collaborating partners to eliminate involved third authorities that overlook all transactions as well as to leverage transparency about products, regarding their basic characteristics, qualitative features, the quantity that circulates, the locations and the ownerships (Saberi , et al., 2019).

Through blockchain's features, meaning the traceability, certification, trackability and verification, users can experience reduced risk regarding financials, performance, or social uncertainty. This is possible thanks to the guarantee that blockchain applications store information about the origin of a good, its authenticity, integrity[7], and location which is facilitated through data access, data storage, information sharing and visibility of all operations in the supply chain (Montecchi, et al., 2018; Fu & Zhu, 2019). Besides, an issue of today's supply chains is the increasing amount of paperwork, which can make up 15 to 50 percent of the costs regarding the transportation of goods. This problem can be tackled by digitizing documents into the blockchain network (Petersen, et al., 2018). Moreover, blockchain technology enables an enhanced demand and supply forecasting and planning due to the flawless transparency in the information exchange (Dujak & Sajter, 2019). Lastly, further literature refers to a social and environmental supply chain sustainability through blockchain implementations. Thus it prohibits manipulations, unfair distributions of assets, and gives the possibility to improve processes by decreasing emissions or excessive resource utilization (Saberi , et al., 2019).

2.4. Trust

Trust builds a basic fundament in the long-term relationship between two or more parties, connecting them and defining the character of interaction. The level of trust for an associate is usually determined in correlation to the level of "dependability", "faith" and "predictability" (Rempel, et al., 1985). Especially faith explains that trust is not only built on feasible rational explanations but also on emotions (McAllister, 1995). These features can result in two forms through benefit exchange between partners or the beneficial reaction of a partner on one's own needs (Berscheid, 1994). Next to these components

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[7] The integrity of a good in supply chains refers to the fulfilment of quality and performance expectations (Evans & Evans, 2001).

determining the trust, the intention of making oneself vulnerable towards the other party plays a significant role, meaning to expose oneself to the risk of loss and failure (Mishra, 1996). Moreover the personal tendency towards trust, past experiences as well as experiences with the certain partners and their reputation play a significant role for the capability of feeling trust (Lewicki & Wiethoff, 2000). A side effect of high level trust is that occurring negative information about an ally are often not perceived harmful and are automatically interpreted in a positive way, whereby a low level trust causes that positive news about a partner do not necessarily have a positive effect as the intention is to turn this information down (Murray & Holmes, 1993).

The literature distinguishes between two main assumption of trust, the "calculus-based trust" (CBT) and the "identification-based trust" (IBT). The CBT emphasizes organizational structures in which trust is created through task accomplishment and thus tends to develop very slowly. On the other side, the IBT stresses the personal character of trust basing it on mutual values and the ability to understand the other's needs or expectation in given situations. In addition, CBT can represent a base for building an IBT which enhances the work relationship in from of "blind" understanding (Lewicki & Wiethoff, 2000).

Nonetheless, the lack of "faith" or not taking the risk of failure lead to distrust that can be equated to the absence of trust (Schoorman, et al., 2007). It is even possible that over the time, a symmetric trust[8] can turn into an asymmetric one due to a partners inability to satisfy the other's expectations (Chang, et al., 2005).

3. Empirical Work

3.1. Data Collection

The thesis relies on a qualitative data collection method containing interviews with three blockchain start-ups. This approach was chosen for the purpose to precisely understand the technological mechanics, personal perceptions, and experiences from different angles. Further, the semi-structured interview was divided into four sections, the introduction part

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[8] Symmetric trust refers to the state when trust is equally balanced between partners, whereby asymmetric trust explains that beliefs in the trusted and trusting entity differ from each other (Chang, et al., 2005)

containing general information, the implementation, followed by opportunities and challenges, and lastly the conclusion containing an outlook and potential limitations.

In order to obtain information that would support the big picture and not being possibly influenced by a single view, the companies were picked out of different industries. After building the first contact via e-mail, a sample was built out of three parties. That contained two European companies and one American firm. More precisely, the European start-ups operate in container shipping as well as post-trade activities, whereby the American is specialized on the pharmaceutical market. Besides, the established interview (Appendix) counts 26 questions including sub questions and endured on average around 55 minutes.

3.2. Interview 1: Tradeline

The interview was hold with George Hantzaras, the CEO of Tradeline.

Tradeline was founded in 2017 in Cyprus by George Hantzaras and George Pappas, and expanded later globally, counting now London, Singapore, and Athens to its new office locations. The business offers a blockchain solution in form of a post-trade workflow automation platform, aiming on facilitating the commodity trading[9], shipping and trade finance. In this context the firm is the first in the industry offering this form of solution to its clients. With the blockchain application, the company further argues to increase the transparency, security, and efficiency, as well as margins and to reduce on the other side the risk in connection with trading partners, potential errors, and operation time. Therefore, Tradeline's solutions tackle three different concerns, the Trade Operations, Supply Chain and Trade Finance by increasing the authenticity and efficiency through tracking and tracing of documents and consequently making the information sharing between involved entities more transparent and ergo erase the need of multiple copies. In addition, the company claims that the elimination of potential difficulties in the supply chain processes could lead to an increase of around 5% in GDP as well as 15% in trade (Tradeline, 2020).

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[9] Commodity trading refers to the buying and selling of goods like oil or metal. Those traders can be businesses as well as individuals (Chen, 2019)

3.2.1. Blockchain & Development

According to the CEO, the blockchain technology is used to digitize contracts and to implement certificates in order to verify the origin of data and create e-documents. These implications should help clients to experience more transparency with their supply chain partners. The company counts to its major customers large commodity trading houses, businesses that operate in the metal and oil industry like Rio Tinto or Anglo American, and shipping and transportation companies. Obviously in the context of a supply chain application, those businesses cannot specify their activities only on certain regions but operate internationally, connecting different entities all over the world.

Concerning the initial development of the software, the first challenges started as there was no given literature explaining whether how to build the blockchain platform nor about the internal processes behind the technology. Afterwards, the obtained knowledge had to be transmitted to the clients through training which often took place in-house explaining the operations and functionalities. In this regard, the CEO highlights the importance of "learning by doing" and that a hands-on mentality is crucial in these stages. The product appearance for the user was precisely developed to not show what processes are active behind the end user interface, because in the end the application should facilitate and speed up daily business and not oblige employees to learn to do something new.

3.2.2. Implementation

Moreover, as an innovation technology business the start into the market is not always easy, a lot in the beginning goes by word of mouth. Later the bigger companies need references regarding the company's background, shareholders, data visibility or data storage. Further, an aspect that could settle the decision to go with one solution or another may be the duration of implementation. Thus, a company would rather go for the company that offers a shortened implementation time than the competitor.

A main concern that stops enterprises from digitizing their paperwork is the fear of hacking and fraud through altering data in the bill of lading[10]. This attitude develops due to the given situation that whoever is assigned as owner in the bill of lading has the right to obtain

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[10] The bill of lading represents a legal document that issues a receipt for over sea shipments containing information about the movement of goods as well as the involved carrier (owner or charterer) and shipper (Mitchelhill, 2013).

the goods specified on it. In other words, when the bill of lading is hacked and the name of the owner exchanged then a cargo is property of this person even though the involved entities are aware of the fraud, there is no possibility for proof.

A big burden for the implementation can usually be found inside the companies themselves. In this regard, precisely internal IT departments can often slow down or even do not make it possible to implement a blockchain solution as the process is connected to structural changes and learning and understanding new things. In general, one could say that the effort is weighted against the advantages of the implemented technology. Reasons for slowing down the implementation process can be complex old-school IT systems which complicate the integration of new software, but also legal departments that ignore the existing problems.

Unfortunately, still many companies are not aware of all the opportunities given with the blockchain, although the understanding of the technology evolved and is not only limited on cryptocurrency anymore. On the contrary side, it sometimes also appears that businesses expect the blockchain to solve complications from the real world that are not feasible to be recorded in the blockchain platform. As a consequence, this is another kind of misconception thinking that the blockchain can also keep track of everything what happens in the physical world without any data entry.

Nonetheless, Hantzaras mentions the innovation adoption curve by Rogers saying: "Nobody wants to be the first, everyone wants to be the second". This explains that no business considers acting as innovator nor early adopter in order to observe first and evaluate the benefit later on. Consequently, it is very difficult for innovative start-ups to increase the number of clients according to the fact that until then no documentations or reports do exist. As a last point for the implementation, one of the rather difficult areas to implement the blockchain technology is actually the supply chain due to its many involved entities.

3.2.3. Problems & Benefits

In the context of international trade, especially the shipping industry is still paper based, like the bill of lading, which includes physical couriering between destinations. 90% of the problems in the supply chain collaboration are paper based and contain documentations, whereby the rest a considered to be smaller difficulties that can be resolved easier.

Nevertheless, another major problem in the supply chain is often the leaking trust. This circumstance builds kind of a dilemma situation as businesses do not consider their partners as trustworthy and keep control by signing everything manually, but on the other hand actually could benefit from transparent accessibility to information through blockchain.

In contrast to average digital applications, the blockchain technology exactly tackles this issue by offering full traceability about the location in which documents were issued, which parties are involved in a transaction and what the next destination is. The blockchain's characteristics of transparency and data accessibility accelerate the enhanced "feeling" of trust. However, the trust between partners seems to be a critical factor that encourages the implementation of blockchain, it yet does not increase but rather diminishes in form of an outsourcing into a platform.

"They did not trust each other, and they still do not trust each other."

Overall, Hantzaras states that the benefits from blockchain are not uniformly appliable on every company as there are differences in needs and application purposes. If some companies use blockchain to gain internal advantage, others will benefit from an enhanced communication or compliance. Like the evaluations of benefits from blockchain for companies can differ from each other, so can also indicators, showing whether businesses are prepared for the implementation or not. Accordingly, Hantzaras says that the organizational structure as well as the management motivation to enforce the transformation are driving factors. The flatter the hierarchy, the easier the decision making across the firm. Generally speaking, there cannot be a point identified how the blockchain could impact a business negatively if the development and programming is flawless.

As the CEO mentions, the real driving factor that matters the most for companies to implement the blockchain is the cost advantage, "saving money or making money". In any case, when another technology would appear to generate a higher cost benefit, the customers most probably would prefer implementing this technology over another.

"When we started, we heard a lot about "super sexy" user interfaces and mobile applications. Okay, that is good, I like it, maybe you like it, but the big companies do not care about. […] If it is working and if it saves money, then it is good. "

3.2.4. Future

Coming to the end, Hantzaras concludes lower expectancy for the near future, but that he assumes the market as we know it today to move away from its traditional structures and maybe even exchange the human labor like agents by IoT devices, speaking about approximately 10 years from now. On the one hand, a reason for the sluggish pace is considerably the fear in people about the unknown. On the other hand, upcoming regulations, like emissions and consumption in the transportation, or the exponential growth of data may be amplifiers for more demand in blockchain or IoT.

3.3. Interview 2: Chronicled

The interview was conducted with Mike Hill, the head of marketing.

Chronicled is a privately traded American company based in San Francisco, California, which was founded in 2014 by Dave Aho, Maurizio Greco, Ryan Orr and Samantha Radocchia. After the company gained expertise over several years in various industries with different blockchain solutions, it finally based its business in the life science industry, more precisely the pharmaceutical sector. This decision was made, due to the fact that a new law, the "Drug Supply Chain Security Act", was announced in 2013 that required businesses to implement an interoperable track and trace system with the ability to connect different entities in the supply chain and making information easier to access. In order to facilitate this process and to set up the infrastructure, drugs were labeled with barcodes containing information, this step was called serialization. In addition, companies had to face many more steps to accomplish the requirements which let Chronicled take the chance of developing a product that could support affected firms. In 2019, Chronicled entered the market with a solution for "Product Verification" tackling especially the concern of the "saleable return requirement" that made the verification of product data before reselling mandatory and represented a lucrative market accounting for around 2% of the drugs in the US market which equals 60 million products. In June 2020, the company launched its second product "Contracts & Chargebacks" which is not as close related to the supply chain but is rather a revenue management process that promotes group purchasing organizations[11]. In simple words, this solution helps companies to return on their

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[11] Group purchasing organizations are buying in big amounts and thus can negotiate lower prices and get better deals (Hill, 2020).

investment within the supply chain. All Chronicled applications use MediLedger to connect different entities and combine product related information by aligning it with every other MediLedger node in each company.

3.3.1. Blockchain & Development

In order to understand the high security and data safety that Chronicled offers its clients, Hill explains that the company's service is built on a MediLedger that contains two sub networks, the blockchain and the peer to peer service. First gives to anyone a general access to a uniform and shared database, whereby the latter one allows entities to exchange sensitive information directly with the other party without restricted visibility for others. This way the company allows enterprise to make their data useable for competitors and at the same time guarantees through the blockchain network that given data is correct.

Especially the understanding of these two mechanisms is crucial for customers as they otherwise lose interest in this solution due to the misconception of an entire transparency for partner as well as competitors. More precisely, the business-related activities are done within the private peer to peer network, including transactions like chargebacks or the exchange of contract and customer information. This enables entities to only share "zero knowledge proof" related content but no sensitive data. The "zero knowledge proof" is stored in transactions of the blockchain, verifying that the company operates fulfills the regulations and that all operation in the peer to peer network are valid. In this sense, everything that happens on the peer to peer network must have first a "zero knowledge proof" in blockchain network in order to be legal. For better understanding, this proof does not show data to anyone but only the confirmation of secure business operations.

For the development process, the head of marketing, mentions that without a collaborative product development there is no chance to develop a proper solution supporting the way partners work together. Therefore, the big players in the market, that they call the "dance partners", are essential in building a suitable application next to further businesses that must be included in a prior testing of the technology, building a suitable sample size. By applying various scenarios companies learn the processes, become accustomed and are able to understand potential weaknesses and strengths of the system. In this regard a collaborative and uniform feedback from all companies together indicating whether a technology serves the needs of the industry or not is important for building the right

network. As the number of clients contains several different trading partners within the network, it can take time until a new technology can finally be released comprising all entities expectations in one product after testing.

3.3.2. Implementation

The major drawback in the first stages, when the new business is entering the market, is building the right reputation, and convincing potential clients of benefits that your product will generate and what they would have to expect. Other than that, word of mouth is another possibility in case that your business has connections to somebody inside the targeted new company and fights for you. Especially as a startup it is not about forecasting demand for your product but rather to scale and generate revenue. The beneficial impact of the growing client portfolio is building connections and making use of the network/snowball effect. This effect does not only help getting new clients into the existing service but possibly also facilitates the market entry of your business's future products. Unfortunately, during the beginning it is not always obvious until later whether all clients are satisfied, but to be realistic small enterprises do not often have the resource to please everybody equally. Even though customers decreasingly associate blockchain with Bitcoin, there is still the negative connotation of a hype technology and privacy leakage, resulting in questions about data storage and protection. Amongst other reactions, prospective clients might experience the feeling of pride in case those have their own teams working on blockchain solutions.

Chronicled's solutions apply their software on the two grand revenue management systems, "Model N" and "Vistex" building a sort of "smart data pipeline". This pipeline enables the direct integration and automated correction from valid data in the systems into Chronicled's software and eliminates the manuals entering. Continuing Hills strengthens the complications in implementation processes caused by existing IT systems within companies that use none of the before mentioned ones, as well as the challenge of diverse security checks and requirements created by the IT departments. In form of pre testing during the implementation, Chronicled builds a "launchpad network" and "test network" in which clients learn to understand the utilization of the technology and can build first nodes in the system and later prove it together with their partners by running sample data.

3.3.3. Problems & Benefits

Going back to the point about the network effect, this is actually the real component that adds value considering that there is a basic number of clients utilizing the platform. Hills refers therefore to the social media platform "Facebook" which only gives a benefit to the user when a certain amount of contacts is also active in the network. Another interesting analogy that Hills mentions in order to understand the positive impact of the Chronicled's MediLedger platform is the comparison of the nodes in the network with an IT embassy that eliminates the need of physical third parties to assure the accuracy of all documents regarding the business rules. In addition, not only costs for third parties are removed but also occurring future costs for disputes regarding data inaccuracy or sending delays.

Nonetheless, the main beneficial reason for companies to adapt the blockchain and peer to peer solution in their businesses is the "return on investment" that acts as a provable success indicator. Thereby it mainly deals about saving money and lowering the costs.

> *"And again, the return on investment does not happen unless you have a lot of companies on the network."*

To this end, Hills clarifies the relevance to only focus on one industry to be successful, more precisely he claims that the true worth bears on the integration of a vertical supply chain. Logically if a company would spread its technology network over several industries it would only be challenging and almost impossible to generate enough trading partners per each sector in order to keep the clients. This assumption is again deeply rooted to the network effect because businesses would only make use and benefit of the network when enough relevant partners would be on it, even in case that the system in reality would operate and integrate perfectly.

In the situation that prior constraints are fulfilled, and customers transfer information to leverage the automation of data verification, there would grow a compounding effect producing value throughout the whole supply chain.

Obviously, this value creation also facilitates trust in collaboration, but not on a voluntary base but rather forced. One could argue that the nature of trust is transformed from an interpersonal relationship based on the human behavior into an error free data processing.

"It would be great if everybody could trust each other, but they cannot, and so they do not. That is what leads to all the issues, and blockchain actually makes trust possible, [...] it codifies trust."

Although the blockchain can give the user a lot of optimization in processes it also holds limitations and risks. A limitation for instance is the loss of control from the provider's side, because once the platform is released it is in the hands of the several nodes in the network. This is followed by the risk of losing data or rather entering and "removing" data from the network, because once data is uploaded to the blockchain there is no possibility to alter data permanently as every transaction always can be tracked back guaranteeing full transparency of all actions.

3.3.4. Future

Asking Hill about his experience in attitude changes from the clients towards blockchain, he denies and stresses that indeed governmental regulations could be drivers for further implementation of blockchain solutions. Needless to say, the law does not oblige enterprises to apply blockchain, but this technology offers a suitable solution for transparency issues and additionally already shows a trend leaning towards its implementation in many businesses. Finally, the business between different parties could be fully automated and giving absolute control on trading actions.

3.4. Interview 3: T-Mining

The interview was conducted with Christiaan Sluijs, the chief financial officer (CFO).

T-Mining is a Belgium company that was founded in 2016 by Nico Wauters, Pascal Verlinden and Filip Heremans, with its headquarter in Antwerp and a second office in Singapore. The company target industry is the maritime and logistics sector in which it offers different solutions in form of smart contracts with the purpose of making interactions between partners safer and more efficient. Further the company aims to enable an intensified collaboration among different parties, to reduce administrative costs and risk by decreasing the amount of paperwork and "manual interventions". Next to the Secure Document Workflow, T-Mining also provides a service for Chainwise Collaboration,

leveraging efficiency through secure data exchange as well as Secure Container Release (SCR). Latter one refers to the declaration of rights over containers which can be protected against fraud with T-Mining's applications. In this regard, the company wants to help businesses to integrate their technology solution in the most suitable way.

3.4.1. Blockchain & Development

For T-Mining it is most important to find application opportunities for its solutions in which the company can detect an added value and an increase in safety for the client. With the blockchain solution, the company leverages the decentralized properties of the technology, allowing the customer to follow its B2B operations more secure and efficient. The blockchain start-up therefore distinguishes its services into document and physical flows, counting certificates of origin and phytosanitary documents as document flows and secure container releases as physical ones. Following up on this, the phytosanitary documentation specializes on the import of fruits or vegetables from different countries. Additionally, the start-up offers a hybrid model that allows its clients to register specific occurrences on the blockchain in other words the statement of facts[12]. Especially for this model it is of high importance to share data transparently with the other parties. An underlying technology of T-Mining's applications is tokenization, the process that also drives Bitcoin. As Sluijs states, tokenization can be explained as transferring things that come with a certain value in form of an untampered duplicate. Additionally, he adds the comparison of an email exchange in which the sender keeps the original message and only sends a copy to the recipient. Further, the CFO stresses that the actual intention of the company is to reengineer existing processes by increasing efficiency through digitization. Unlike other companies, T-Mining manages to offer a solution designed to fit all customer needs and to allow parties with a mobile application to participate within the blockchain network without running any node. For the development process it can be said that even though blockchain is part of a fast pacing market, it is still more time demanding to develop than cloud applications which are centralized technologies.

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[12] The statement of facts represents a chronological documentation of actions of a vessel during a stop in the port (BV, 2013).

3.4.2. Implementation

In contrast to the other interviewees, Sluijs explains that in most cases companies contact T-Mining in order to initiate new projects implementing blockchain for their businesses. The majority of these enterprises can be defined as innovators that ask for redesigning business processes, one of those is the Mediterranean Shipping Company S.A. (MSC) that is one of the worldwide leading companies in this field. Other clients of T-Mining are further ship owners and freight forwarders[13]. The following real-world project is extremely interesting considering the start-up's collaboration with the port of Rotterdam in which the customer wants to eliminate paper documents through timestamping. Therefore, the blockchain service can support this idea by registering all actions and vanishing the risk of disputes.

Due to its decentralized character the implementation of blockchain is especially more complicated inside bigger companies as it requires a software installation on the client's device prior to the utilization of the blockchain. More specifically, Sluijs mentions that a burden is sometimes the leaking technological skillset of the client, or the internal protection with firewalls[14] against cyberattacks[15] that often demand a higher complexity in procedures to integrate the technology on the PCs and servers. One of those necessary implementations are the wallets which contain the credentials of a client, including the public and private keepers. On the contrary, the user interface (UI) of the web and mobile apps are easier to grasp, for what T-Mining does not consider further instructions to the user. Even if the integration process turned out to be successful, another decisive factor is the number of collaborating partners that run a node on the blockchain. Therefore, it is first recommendable to consider the application of blockchain as soon as a coalition agrees on operating with the blockchain.

An additional drawback for the implementation that is rather related to the attitude of the users, is the insistence on old models. Sometimes it might happen that customers want to stick to the traditional working patterns as a result of leaking understanding for the

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[13] Freight forwarders are responsible for the administrative booking processes of a transport controlling the delivery time as well as the quality of delivery (Burkovskis, 2008).

[14] A firewall can be understood as a filter that controls the traffic between networks aiming to protect organizations against unauthorized access (Vasudevan , 2016).

[15] The term cyberattack refers to the state in which a computer network is being damaged and disabled by an external entity (Hathaway, et al., 2012).

technological concept behind blockchain. But especially the step to do something different than the competitors can give an enterprise an advantage in the market.

"It is not about the unknown, it is really about trying to think out of the box."

On the other hand, Sluijs points out that blockchain is not always the right answer for companies. Nonetheless, some enterprises do big announcements about blockchain implementations even though the technology is no good fit for their issues. He traces this behavior back to a showing off action or the will of being considered innovative. However, this misuse sometimes can also have deeper roots in which simply a misconception of blockchain plays a significant role. In earlier stages, people were most of the times guided by newspaper articles mentioning blockchain and some specific company names, but certainly Bitcoin was the dominating understanding of the technology. Nowadays, the mindset made a step away from this perception and businesses tend to understand the digital format of blockchain increasingly better.

3.4.3. Problems & Benefits

A major condition for the blockchain to work smooth and to unfold to its full potential is a mandatory base number of collaborators that are willing to utilize the blockchain network. This innovative technology emphasizes the collaborative power in the business world and supports companies in leveraging their overall performance. In this context Sluijs mentions an interesting article from McKinsey about the "Competition Paradox" which summarized illustrates how former competitors now can turn into working partners facing a common goal and benefit from it. For this purpose, blockchain solutions can help integrating various databases into one and interconnect all different systems. Simply put, the blockchain enables the conjunction of data silos. Simultaneously this allocation of databases helps diminishing errors and inconsistencies in the information. In order to facilitate the entry into the technology, the blockchain company takes away the complexity and offers the end users a clear layout hiding the underlying back-end technology, the blockchain solution.

A driving factor that catches the interest of several companies is the cost advantage considering the savings in paper documentation and the related printing costs through the notarization function of blockchain. This property allows businesses to additionally

eliminate expenditures regarding third parties for document authorizations. Another benefit resulting from the use of blockchain, is the reduction in risk concerning data privacy. Following up on this, the CFO stresses the advantage of blockchain solutions over cloud applications in an example about database acquisitions in which third parties or competitors acquire a centralized database which makes all the contained information accessible for this one company. Consequently, this leads to the unfortunate position in which you as a company must disclose unwillingly your data, your confidential, to the opponent which on the other hand is not possible with blockchain as it is an decentralized technology that detects fraud immediately. Catching up on the point regarding third parties, blockchain allows coalitions to overcome those central authorities that are setting up rules, control the whole network and have insides into all information. Besides, blockchain improves the data privacy because it reveals the notarization, the hash, to other parties in the blockchain but never specific information as these are only exchanged in a peer-to-peer connection.

Continuing the complication of hacking and fraud in general allows the blockchain to leverage trust in between partners up to this level that you can trust the technology. In this sense, Sluijs introduces a new comparison of trust with money, saying that having a 20-euro note is truly just paper, but we give it a value and trust into it. Furthermore, the blockchain allows with its hash validation to be sure about the authenticity of an item which does not increase trust but rather ensure it through a technological proof.

"I can trust the technology. That is the idea behind it."

Indeed, the blockchain solution has a limitation in its scalability which means that a new node does not influence the technology's capacity, in fact, it only adds a new user that must be synchronized. Moreover, the service also creates the question of monetization and how the network can be validated in terms of ownership rights. An equally important challenge of blockchain might be the consideration of prior outsourced costs from businesses that used a cloud-based solution, because services like data storage, hardware, or memory must be taken back in-house again. Finally, companies have to be aware of the fact that the decentralized ledger technology is not solving privacy problems as it is universally accessible from all entities.

3.4.4. Future

Sluijs expects for the future that the supply chain still will offer broad opportunities for blockchain solutions regarding its big number of collaborative participants. Beyond, he anticipates that the technology could replace middlemen and reformulate today's business models. In this regard, travel agencies might be a good estimator for what could happen as they were exchanged by technological solutions like Booking.com and others. What those solutions combine is the connection of supply and demand what the blockchain technology can perform perfectly. Additionally, the CFO emphasizes the continuous redesigning of companies in the long run estimating that enterprises will digitize and decentralize their processes in order to stay competitive in the market.

4. Findings

This study emphasizes the impacts of blockchain technologies in the supply chain collaboration and explains the experiences and assumptions from clients towards this software solution. The sample of three geographically independent businesses that operate in different industries illustrates that regardless of the environment, the implications are overall the same, covering the implementation process, benefits, challenges, and limitations.

Getting back to one concept that was mentioned during an interview, the innovation adoption curve ("bell-curve") from Roger could be an interesting indicator for the forthcoming development of the blockchain technology. Nowadays, experts consider blockchain to have reached the beginning of the early majority stage in which increasingly more companies raise interest and start internalizing new innovative products in their operations (Luu, 2018). However, one interviewee even stated that most of the clients in the blockchain industry are still innovators. This position allows to assume that the market will still experience a great boom in which the attention will increase and gather most clients, putting into consideration that not even half of potential businesses were reached.
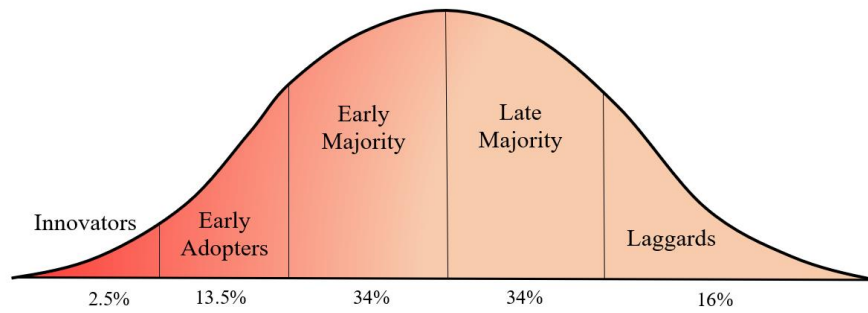
Figure 2: Innovation Adoption Curve (after Roger, 1983)

The first stages of an innovation technology company can be complicated due to the missing product reputation. Thus, an essential step to increase the customer portfolio is the word of mouth concept or network effect, inter alia snowball effect. Not only do these generate a better entry chance to the market, they are also driving factors for the value added for enterprises that are using the blockchain solution. In this regard, not only leveling up the number of customers without strategic focus on a certain industry will make a provider scalable, but rather the specific collecting of clients in a single industry in order to reach a high market coverage and make in here use of the network effect which leads to a marginal social benefit. In other words, crucial is the vertical integration of blockchain into one industry. Finalizing, the more relevant partners of a company are on the network the more valuable it is.

The implementation processes though can be challenging for blockchain developers especially in bigger companies as existing IT systems sometimes do not align with the blockchain solution and make the "plugging in" into the system more difficult. Another technical disadvantage may be the protection of firewalls against unauthorized organizations. But also, misconceptions of the technology like assuming that blockchain is Bitcoin or that everything deals about cryptocurrency, can slow down the implementation process in which the providers first have to start clarifying the functionalities and range of applications of the product. Accordingly, now and then also failures in implementation can be attributed to the simple fact that companies ultimately just integrate blockchain into their processes without even having a specific need but just for the purpose to build an innovative reputation in the market. Beyond that the missing imaginative power of customers to understand the capability of blockchain drives the insistence on old models and harms the technology to develop its full potential. On the contrary side, features of enterprises that can facilitate the implementation are supportive IT departments and

managers as well as flat organization structures that enable easy communication through the different departments.

Especially in the supply chain, which is obviously the most difficult business area as many entities are involved, blockchain can offer trading partners the opportunity to exchange data in real-time, having verified authenticity regarding documents and full transparency which reduces the risk of fraud. Nonetheless, latter characteristic still keeps a lot of businesses from implementing blockchain according to the fear of opening sensitive information to unwanted parties like competitors. In this context, the blockchain architecture obviously leverages business operations through transparency but this lies on a so called "zero knowledge proof" that authenticates that the collaboration with another party in the network is valid. Due to its validation property and decentralized character, the blockchain technology opens the doors to a collaboration without central entity or middlemen. In this term, one interviewee brought up the "Competition Paradox" of McKinsey, illustrating the raising power of collaborations that jointly work towards a goal.

Consequently, one could believe that trust improvement is a great reason for the technology adoption, though it only accounts to a small part of the incentives. The main cause is the cost advantage and return on investment given through less errors and disputes as well as the elimination of expenses for third parties and paperwork. Coming back to the point of the trust enhancement, this study showed that the blockchain does not produce any increase in trust between the entities but in truth somehow outsources this issue by digitizing it in form of verification processes which do not give space for betrayal. To put it in fewer words, trust issues can be decreased but trust cannot be built. Additional benefits from the blockchain are time reductions as documents for instance do not have to be exchanged physically anymore, transparency and facilitated operations. Obviously, the major drawback for integrating the technology into the business operations may be the immutability of data in the network. Of course, data that was entered into the platform can be changed, but still due to the blockchain nature every altering can be tracked back to its origin what at the same time helps in the fraud detection.

Overall, the blockchain technology is expected to move towards a promising future with its already arising trend in business integrations. Leveraging effects could be prospective regulation by the government engaging companies to meet the conditions of full traceability and trackability as blockchain comprises these qualifications in its technology. Despite the legal possibilities, the increase in data as well as the will to position oneself

competitive in the market could be further driving factors to digitize processes and disrupt established business structures. However, blockchain providers will still face the unsolved limitations regarding the scalability as well as monetization of the blockchain.

5. Concluding remarks

This thesis shows the analysis of blockchain implications on the supply chain collaboration referring to the implementation process, impacts on trust between supply chain partners as well as further benefits, challenges, and limitations of the technology. Especially since the globalization forces organizations increasingly to operate internationally, the blockchain application can generate a solution for interconnections across the world. These collaborations are most of the times suffering from distrust leading to social dilemmas between personal advantages and collaborative success. The basis of these trust issues is frequently the fear of being deceived by the associate through withholding information or not contributing in the full potential.

In order to gain a deeper understanding of the connection and effects of blockchain solutions in the supply chain collaboration, the empirical part was based on a quantitative methodology containing 3 semi-structured interviews with blockchain start-ups from San Francisco, Antwerp and London, that were conducted via video conferencing. Each of these businesses is providing its blockchain service for supply chains in different industries, including the metal and oil sector (commodity trading), pharmaceuticals and the maritime and logistics industry. This variation helped to grasp an overall impression without being influenced from a single perspective.

To conclude the findings, it was clarified consistently that trust between partners cannot be improved through blockchain but rather outsourced on the blockchain technology through its underlying validation processes. However, the motivators for businesses to implement the technology rely on the financial benefits in terms of cost advantages and the return on investment due to fewer mistakes as well as the exclusion of intermediary parties and the reduction in paper-based documents. Further, it has proved to be challenging for blockchain providers in first stages, for what the network effect is an essential driver to reach the potential audience. For the technology's implementation, providers in general face one major problem which are existing IT systems and firewalls in the client's networks

that complicate the integration of the blockchain software. Although it appears that blockchain has a promising future ahead, there are still challenges to face considering the leaking scalability and monetization of the network.

As blockchain technology is still not implemented in many businesses, there is a lack of data for a further quantitative analysis that would represent a suitable sample size including the numbers of many companies. Not only could such data demonstrate clearly what impact blockchain has on the revenue side, it could also help detect potential differences across industries. As a matter of fact, it could be considered interesting to know whether the impacts due to the blockchain implementation are truly unified throughout the supply chain or if there are appearing differences on the benefit and difficulty side. One of blockchain's main characteristics, the full transparency, prevents potential customers from the usage due to the fright of unintentionally disclosing data to competitors and thus impair the level of privacy. However, this misconception of blockchain does not represent the true technical operation behind the technology as competitors and other entities would never be able to see sensitive data from a peer-to-peer transaction but only the "zero-knowledge-proof".

Further, the thought occurred that building the application vertically into supply chains may result in the situation that only a few blockchain providers could maintain competitively on the market in the long-term, having full control. This setting might emerge as the implementation process is time consuming and complex, and thus switching costs to another provider would be too high. Consequently, once certain blockchain companies would have a high industry coverage it might be only a matter of time until other competitors would be pushed out of the market.

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Appendices

<u>**Interview Questions**</u>

Part 1 – Introduction Blockchain Technology (BT)

1) How does your company apply BT?
    a) In which way do you offer your own BT to clients?
2) What are the typical clients with whom you work?
3) In what aspects can your blockchain solution (BS) add value to your client's business?
4) Which attitude do your customers have towards BT?
    a) Which reasons can you usually identify that explain why companies still do not use BT in their supply chain collaboration (SCC)?

Part 2 - Implementation

1) Which challenges could you observe in the past with the implementation of the BT?
    a) How do implementation processes of BT for companies differ from each other? (company evaluation, benefits, potential problems…)
2) How did the interest in BT from companies change throughout the years?
    a) To what extent are your clients aware of the possibilities with BT?
    b) How would you describe their driving factors to implement your BS?
3) From your personal experience, how do clients react to the changes through BT implementation?
4) What are good estimators indicating whether a firm is ready for BS or not?
    a) Could you think of any reason for non-successful implementations?
    b) Are there industries that are especially ready for BT?

Part 3 – Challenges & Opportunities

1) Can you tell me why trust is so important in the SCC?
2) How did you personally experience the trust issue between supply chain partners?
    a) Of what reasons for the trust issues between collaborators can you think?
    b) How can your BT solve trust issues between partners in the SCC?
3) Could you think of further problems regarding SCC and how BT can help?
4) Did you experience that the relationship between SC partners changed with the adaption of the technology?

Part 4 – Conclusion & Outlook

1) How do you expect the supply chain to change in the near future? 10 years?
2) Of what limitations for blockchain can you think?
3) Can you imagine any aspect of how blockchain could affect a company negatively?
4) Have we missed something you think is important and you may want to add?

Interview 1 – Tradeline

Magdalena Paula Brück

Let me start with the first question. How does your company apply block chain itself?

George Hantzaras

Well, a part of our platform is about supply chain and then another part is about trade finance, because what we do is, we automate the whole commodity trading life cycle. So not only supply chain, trade finance as well and trade contracts and so on. Now, what we do is we use blockchain in order to digitize the contracts and implement via blockchain certificates and within the blocks in the ledger, we implement these signatures for all the contracts and then in order for this to circulate and exchange the data. That is where we usually use also blockchain in order to verify where the data has come from and so on.

Magdalena Paula Brück

All right, so giving a little bit more transparency? To understand this correctly.

George Hantzaras

Yeah, definitely.

Magdalena Paula Brück

And what are the typical clients with whom you work with? Like which industry, which company sizes or in which regions?

George Hantzaras

Well, we work with large ones. The biggest, the most important clients are our large commodity trading houses or whoever is the charter of the vessel. So, you've got like Shell and BP or [...] Vitol or [...], you know, all that kind of guys. Or even metals' guys those guys like Rio Tinto, Anglo American. They are the guys that have the cargo and they need it to be transported to different places. And then also the shipping companies and the transportation companies as well.

Magdalena Paula Brück

All right.

George Hantzaras

And typically, especially the first are huge organizations of a few hundred thousand employees each. So, they are pretty big and. Well, there is no geographic specific big, because usually you want some cargo transported from Latin America to China now or whatever. So geographically, it is by default global.

Magdalena Paula Brück

OK, all right. So how many years, are you know, in the market?

George Hantzaras

We started four years ago, three and a half years ago. But the platform is up and running two years now.

Magdalena Paula Brück

Wow. So, it is actually a really fast growing market! And what do you think or what would you say, in what aspects can the blockchain technology actually add value to your client's business?

George Hantzaras

Well, the most important that I think is really important also for you to build a case around it, is that in supply chain, everything is still paper-based, especially in shipping. You see that the bill of lading is, you know: the vessel is loaded and then they issue the bill of lading physically and they take this and they courier this to the to the destination and everything happens with physical paperwork. And they actually take the paper and they sign it physically next to the vessel, which is crazy. So, we try to see why this is still paper based and why they do not want to digitize these contracts. And the reason is that nobody trusts anyone. If you take a vessel and you load two million barrels of crude oil in it, that is worth today like 50-60 million dollars. But you have the bill of lading. If the bill of lading is digital and then you hack it, this is a proof of ownership. So, if I changed the name on it,

then the vessel master must give me the cargo, even if he knows it is hacked. If the paper says that, then the cargo is mine. And that is why they did not want to make it digital. They were really afraid to do so. That is where the problem comes in. We can provide full traceability of, where the documents are issued, who issues them, where they go on next and so on.

Magdalena Paula Brück

That is interesting. And which attitude do your customers have towards blockchain technology then specifically?

George Hantzaras

Well, now it is a bit better. When we started, everyone's first thing was: hahaha, we are going to have to buy cryptos now. And we are like: No, it has nothing to do with cryptos, it is just a good part of it. Now people know a bit more, but again, you know, when you reach the IT department where they have to do a lot of changes and learn your stuff and you know, people usually in a thousand employee companies, most of them do not want to learn your stuff. Then is where the hard part starts. Everybody likes the idea of digitizing and saving by 30 million a year. But nobody wants to do the effort for it.

Magdalena Paula Brück

Okay. And which reasons can you usually identify that explain why companies still do not use the blockchain in the supply chain collaboration? Is it because of the implementation, as you said, or are there more features? Is it fear, is it the unknown? Or is it really just that the limited knowledge on cryptocurrency and they do not know how to do it with supply chain?

George Hantzaras

Well, I think now they have moved away about from this "it's all crypto", but I think it is still unknown and I think that is it. I do not know if you are familiar with the innovator curve. No one wants to be the innovator nor the early adopter. Everyone wants to be later on after the later stages of the bell curve. So, I think, what we usually say, for fun is that

nobody wants to be the first. Everyone wants to be the second just to see what happens actually.

Magdalena Paula Brück

All right. But it is still a fast-growing market, as you said. Well, now let us go a step further to the implementation. Which challenges could you observe in the past with the implementation of the blockchain?

George Hantzaras

Well, when we started three and a half, three years ago, the hardest part is that it was uncharted territory, no documentations. We tried to figure things out on our own. There were very few. When you start developing in software, you have a lot of traditional tools that help you during software development. But then for blockchain software development, we had to build everything on our own, for administration, for management, that kind of stuff. So that was the hardest part. Then we had to dig into the software and try to learn how it works rather than reading documentation. There were no books about it or anything. That was the first problem. And the second was, well, the first client we ever mentioned. They had no idea what we were talking about. So, we had to educate everyone, we had to do like trainings. And that was also a hard part.

Magdalena Paula Brück

So, are you in-house with the clients, showing them the software, how it operates?

George Hantzaras

A lot, yeah.

Magdalena Paula Brück

Wow. And how did the implementation processes actually differ between the companies? Are there differences? Like when you evaluate a company, different benefits or that the problems that you see are different?

George Hantzaras

Sorry, I did not get that.

Magdalena Paula Brück

When you implement the blockchain for different companies, are there evaluation differences or can you see benefits that differ. That some companies can benefit this way, others differently?

George Hantzaras

In the benefit side, yeah there are differences. Some just need a lot more organization internally. Some others use it for better communication between different offices and across the world. Other like the compliance side of it, because they use it, to have a paper trail of everything. But then on the hard part, on the on the difficulties, I think it is pretty much the same for everyone. They all have these complex IP systems which are really old school and it is hard to integrate with those, or they have old school legal departments and it is really hard to even talk with those guys. This is pretty much the same. If you have legal and compliance guys, that do not want to really care about the problems, then it's really hard for you for them to shift it and explain.

Magdalena Paula Brück

So, it is rather always the internal problems that they actually do not want to change something.

George Hantzaras

Yeah.

Magdalena Paula Brück

All right.

George Hantzaras

Everyone likes change in theory, but, they actually do not want to do it.

Magdalena Paula Brück

Yeah, I understand. And how did the interest for the blockchain technology from companies change throughout the years? Could you recognize some shifts?

George Hantzaras

Yes, definitely. Now it is a lot more mainstream. At the beginning, when you said blockchain everyone was like: "OK, this is a kind of a hype thing", or they were saying it to raise money or, I do not know, whatever reason. But now, a lot of people, have understood that there this huge benefit and a lot of people are interested to hear what you have to say.

Magdalena Paula Brück

Okay, but to what extent are the clients aware of the possibilities? Is it just like the trend, that it is mandatory, or why?

George Hantzaras

They know very little. A lot of times they know little, but they think they know much. But still, they are a lot more open to learn stuff.

Magdalena Paula Brück

And what is usually what they think about blockchain possibilities? What is their usual point of view?

George Hantzaras

Well, the most usual misconception is that they think that blockchain can solve problems that are not even solved in the physical world. Like what they were saying is that: Okay, you have the bill of lading, which is the load document of the of the vessel, an then you take this to issue it digitally. And then you want to click and print it and send it to someone physically. And then he scans it and uploads it. And then I have a digitally and I want all of this to be in the blockchain. But this cannot really help them. You cannot track what

happens in the physical world if no one logs it in the system. The good thing about blockchain is that no other system can do that.

Magdalena Paula Brück

So sometimes it is really the misconception in their head, that they do not specifically understand the blockchain?

George Hantzaras

If you read, there is this huge hype and everyone believes blockchain will solve every kind of problem. Of course, that is the case that it solves a lot of problems but not all.

Magdalena Paula Brück

Okay, all right. And what would you say are then the driving factors to implement the blockchain?

George Hantzaras

Well, the most important, I think, and it is the only one that matters actually, is the driving factor for all change, saving money or making money. That is what is going to make a B2B software work if it is blockchain, if it's not if it uses AI, IoT or whatever other technology. Only if you make money or if you save money, then they are going to use it. And it is important because when we started, we heard a lot about, "super sexy" user interfaces and mobile application and everything. Okay, that is good, but you know, I like it, maybe you like it, but the big companies do not care about.

Magdalena Paula Brück

They want it just functioning?

George Hantzaras

Well, if it is working and if it saves money, then it is good.

Magdalena Paula Brück

And from your personal experience, how do the clients react to the changes through the blockchain implementation during and after the process?

George Hantzaras

Well, what we have done from a user experience perspective, we have tried for the end user, so for the trading companies and the guys that are using it every day, we have developed it in such a way that they do not understand if it is blockchain on the background or whatever happens. So, we have tried to hide everything so they can just do their work like they normally would. Instead of opening Microsoft Outlook and sending an e-mail, they open the Tradeline platform and type something there. And everything happens in the background., so IT teams know what happens, but the end user, the trader, would never know. And I think that is also an important factor because the guys that have to do a specific job, they do not want to learn to do something else. They do this and they want to keep on doing this.

Magdalena Paula Brück

But this is now for the financial trading, when I understand it correctly? And in the supply chain, how did they react there during or after this implementation?

George Hantzaras

When I say trading, I do not mean financial.

Magdalena Paula Brück

Okay.

George Hantzaras

So again, the same the guy who does supply chain operation, he does not really care about learning to use a new IT system. He actually wants to do his job faster.

Magdalena Paula Brück

And you offer your plans as fast entry to the system without a lot of training?

George Hantzaras

 Correct.

Magdalena Paula Brück

All right.

George Hantzaras

And that is also important for me to be stopped because, for example, we have a German paper company, if you go and buy a really good system from SAP, it is the best in the world and you can do whatever you want with that. But you need like one year to implement that customized. If you go into a company and say: Okay, instead of one year, you are going to use Tradeline and you are going to need two months, then that also makes a huge difference.

Magdalena Paula Brück

All right. And what are good estimators indicating whether a firm is ready for a blockchain solution or if it is not?

George Hantzaras

Well, it depends. I would say a good indicator is the organizational structure of the company. So how flat it is, how easy decisions are made across the organization. And the other is how motivated is the management to push this change? So, for example, there is this huge commodity trading company that they are now trying to put Tradeline in, because last year they saw like 70 percent reduction in their profit. So, if the management really needs a change, to go to the board and say that we are implementing something that is going to be groundbreaking, then that is always a good sign.

Magdalena Paula Brück

Right. And the first point you said was that the hierarchy, when it is flat, it is probably better?

George Hantzaras

Yes.

Magdalena Paula Brück

All right, that is interesting. I did not know it. And is this also a reason for an unsuccessful implementation? Or could you think of any other reasons?

George Hantzaras

You mean for us specifically or totally different companies?

Magdalena Paula Brück

No, for you specifically as a company where you see that implementation is not successful? What could be reasons?

George Hantzaras

It is 100 percent that, if you reach a point where you have like IT, compliance, trading and supply chain and they cannot communicate with each other because they are like silos in their organizational structure, then at some point, you know, six months later, we cannot work with you.

Magdalena Paula Brück

And do you think that there are industries that are especially ready or interested in the blockchain technology?

George Hantzaras

Especially ready. Well, I think my opinion is that supply chain is a hard one because there are a lot of involved parties. So, for example, you have a vessel when you go to the port

involved in. In this transaction for the vessel to load there is the buyer, the seller, the shipping company, the load agents, the inspectors, the port authorities - this is probably the best-case scenario. Only six and, oh and the customers, seven. It is really complicated and they are really old school, so I would say supply chain is the hardest one. I have made some bad life choices, apparently. I would say, well, everywhere that you have, data privacy, like personal sensitive data like medical records, stuff like that, I think there is a space for blockchain.

Magdalena Paula Brück

OK, all right. And can you tell me why trust is so important in the supply chain collaboration?

George Hantzaras

Well, the most important thing is what I told you earlier about the bill of lading, the load documents, especially in vessel transportation and also in ocean transportation. It is a proof of ownership. So, if you steal it from my bag, then you are the owner of the cargo. It is like a pirate, whoever has the paper has the cargo. And that is why they do not want to make it digital.

Magdalena Paula Brück

And how did you personally experience trust issue between supply chain partners?

George Hantzaras

Well, to be honest, we started with a lot of like word of mouth and people we knew and stuff like that. So, at the beginning, it was kind of good when we started going to the really big companies and people that we did not know, and we just met. They always ask: Who is behind the company, who are the shareholders, who is going to be able to see our data, what are you going to store on your servers? But that is exactly where blockchain can help us a lot because everyone wanted to share data with their own servers. And we were able to do that with blockchain and we have a web application where we actually do not store any of the data, which is groundbreaking. If you go to Microsoft, Google, everyone stores your data, and with blockchain you cannot do that.

Magdalena Paula Brück

And so, you say that for the trust part, it is actually that the data is really stored and transparent and accessible? That this is a reason for the trust increase?

George Hantzaras

Yeah.

Magdalena Paula Brück

Okay, perfect. And could you think of any further problems regarding the supply chain collaboration and how the block chain technology can help there?

George Hantzaras

Well. To be honest, almost like 90 percent of the problems is document related. So, it is exactly based. A minor part is sometimes, payments and how these are mediated between parties, what you pay to the shipper, what goes to the ports and the agents, and all the cost accounting, which is a smaller part, which could be programmed through smart contracts. But this is a lot more minor.

Magdalena Paula Brück

Okay.

George Hantzaras

But I would stay with, you know, document related stuff.

Magdalena Paula Brück

And did yourself experience that the relationship between the partners changed with the technology?

George Hantzaras

Between the partners. Yes. So, you mean between the different companies there?

Magdalena Paula Brück

Exactly. If you could experience or see that there were some shifts, or that you got feedback?

George Hantzaras

No. They did not trust each other, and they still do not trust each other.

Magdalena Paula Brück

They just automate it, so they do not have to fear too much?

George Hantzaras

 They are outsourcing trust.

Magdalena Paula Brück

All right. And now I would come to the last part. How do you expect the supply chain to change in the near future and also in the long term?

George Hantzaras

Well, in the near future, meaning like three years from now, I would say not as much as we would want. So, I would see some e-signatures and like five years ago technologies getting adopted. But then, really, really disruption of the market, then changing the way things work, an automatic clearance from the customs and even getting agents out of the way with IoT devices and stuff like that. I think we are talking probably 10 years from now. And there is huge space, but it is really slow, and people are really, really scared.

Magdalena Paula Brück

But you also think that the blockchain still will be a significant role in the long term?

George Hantzaras

Yes, I believe. Well, even if we move at the point, as I said, with a lot of devices, there is especially in vessel transportation, ocean going transportation, a lot of regulation going on about the emissions and fewer consumptions and stuff like that. And everyone in the shipping industry is trying to apply IoT or IT devices for smart metering and stuff like that. And you see a huge growth of data, of amounts of data, which is really sensitive data, positioning, specifics of the vessel, specifics of the cargo. And these are the things that could work really good with blockchain technology in order to take the data to integrate it inside. So, I think those are two technologies that are going to make a huge difference and work together.

Magdalena Paula Brück

Okay, awesome. And of what limitations for blockchain can you think?

George Hantzaras

Well, about, I think it was a year and a half ago, there is this digital conference in London that I was sitting there in a panel discussion and there was this guy, who was asking: "I am always there in international maritime organization. So, all these regulations from the IMO about the emissions, how can blocking help? And the answer was it cannot. There is a lot of stuff that, you know, you cannot help because it is physical. You have especially in supply chain to transport huge amounts of stuff, and a lot of parties are involved in and it is a cross-border transaction all the time and some stuff is there and blockchain can definitely not help.

Magdalena Paula Brück

And can you think of any aspect, how the blockchain could actually impact a company negatively?

George Hantzaras

Negatively. Well, if implemented properly, no, not really. Of course, you could do a lot because there is this distributed system nature in blockchain, where if you implement it wrong, your data can all of a sudden become public, all of it, which is definitely not good.

I think if implemented like that there could be some security and privacy aspects, but if implemented properly, no. I cannot think of something.

Magdalena Paula Brück

So, the implementation problem is rather from the programming side of the software?

George Hantzaras

Yes.

Magdalena Paula Brück

This was actually my last question. If we have missed anything or you want to add something more?

George Hantzaras

No, I think we covered a lot.

Magdalena Paula Brück

Thank you very much.

Interview 2 – Chronicled

Mike Hill

Well, let me give you a little background. So, Chronicled started in 2014 as a sort of general blockchain company. That thing this was to build block chain and figure out where the most likely applications would start gaining adoption. So, they tried a few different industries outside of health care before we sort of landed on health care. And just to be clear, right now, our focus is on the pharmaceutical industry. We have plans to expand to other use cases within other aspects of the health care industry. But I think one of the most interesting things about blockchain is that it is very similar to Facebook in the way that it grows. It is only valuable if your friends are already on it. You need a sort of core group of companies that are actively trading and doing business together to be on the network for it to be valuable to each one of those companies. So, it is sort of very specific hyper focused, localized strategy. It just makes sense compared to, I think, a lot of other companies outside of blockchain. So, within the pharmaceutical industry and also to be clear, we are focused on the US market where there are maybe five hundred pharmaceutical manufacturers that sell drugs in the US. There are maybe 20 distributors, only three wholesalers, in fact, that control almost 95 percent of the entire market. So, it is very hard to sort of vary a lot of focus on three major vendors. And then there is a number of mechanisms for how hospitals and pharmacies interact with the pharmaceutical companies. So, it is so, you know, there is maybe 80000 dispensers. There is the term that you use for drug. So, for pharmacies and hospitals and anybody that is purchasing drugs, that includes, the U.S. government or nonprofits like the Red Cross, things like that. So maybe 80000 customers and then a few others are types of companies that operate in this space. So that is sort of the market that we are in. The way that we use block chain is very specific. So, we have a network called the MediLedger Network. And the goal of the MediLedger network is to bring trust and automation to processes between companies. That there is a lot of different processes that sort of each have their own use case and implications for blockchain. Obviously, like supply chain as a whole is, there is a lot of like it. Automating the supply chain is a very broad term, and so it is within the supply chain, you have to get more specific in how you actually build solutions that can be used. So, the MediLedger network right now serves two functions with two solutions that we have launched to date. The first solution is focused is one certain niche aspect of the supply chain. It was launched last year in twenty 2019. And the goal of that really was to sort of kickstart the network. One of the reasons that pharmaceutical industries adopt blockchain is, I think a little bit

further along than other industries is because there was a law passed in the US in 2013. It is called the "Drug Supply Chain and Security Act2. Have you heard of that?

Magdalena Paula Brück

No, I was not aware of it. I think we do not have it in Europe.

Mike Hill

Yeah, I think that there are other regulations. Right, it is a US law. But there are other implications of locking down the supply chain under state tracking and tracing of drugs. It is a lot of the world is trying to do a better job of that. So, there are regulations everywhere. But if you are you know, you should definitely research this law because it is the sort of single driver, single major reason why the pharmaceutical industry is adopting blockchain, it is because of this law.

Magdalena Paula Brück

It was in 2013, right?

Mike Hill

It was passed in 2013 and basic and again, so it is called the "Drug Supply Chain Security Acts", DSCSA. The goal of the law was to put in place a series of requirements sort of spaced out over the next 10 years, ending with a full requirement for a "track and trace system" for drugs. So, the industry by 2023, so 10 years after the law was passed, has to adopt a full track and trace interoperable system, meaning it can sort of talk and communicate with other systems and things. So, everything is automated for understanding the location at any given time, the source, you know, certain identifiers. There is a whole list of requirements for drugs from sort of manufacturer all the way to the dispenser, the pharmacy. So that is the twenty, 2023 requirement. And that is sort of something that a lot of the pharmaceutical companies are already investing in. They are setting up infrastructure. There are all sorts of things that need to happen. There is for the first, you know, four or five years, there was a big effort called serialization, which was basically putting barcodes on all the products that had more data than just a single identifier. They had manufacturer name and ID and manufacturer data and production number. And there

are all sorts of other identifiers. And so, there was this whole effort to actually create a serialization strategy. And once you have this serial number of barcodes, you can start doing scans that integrate those numbers and the systems, and that makes it possible to start doing track and trace. And so, there are all these series of steps, that companies need to take. So that is the law. Our product that we launched last year was meant to help companies meet the 2019, which is now 2020 requirements within that law. So, this is just one of the requirements. But it is called the "saleable returns requirement". So in that law, one of the things they required was that when a pharmacy decides they purchased too many products, too many drugs, and they need to return it to the wholesaler before the wholesaler can resell those returned drugs, they need to verify that those drugs came from the correct manufacturer or the date number, the date manufacturer date matches, the identifier matches and then the production number matches. So, like they basically need to verify that product data. So, it is called the "saleable returns requirement". Any drugs that are still saleable. Once they return, they have to be verified before they can be resold, and so it accounts for maybe two percent of the entire drugs and all of the drug sold in the US. So maybe 60 million products and others. And so it is basically it is an application for blockchain where the participants in the network are met, pharmaceutical manufacturers and the pharmaceutical wholesalers, of which, again, there are three major wholesalers in the US that control most of the market, 95 percent of the market. So, all three of the wholesalers are using MediLedger already and they are doing verification on for all the manufacturers products. So, the product is being sold to both wholesalers and manufacturers. And the manufacturers maintain their list of products. It is called GTIN which is a product identifier number, but they maintain their list of products in their own system, the MediLedger node in each company sort of in sync with their system and their list of products. And then it perfectly aligns that product list with every other node, but obviously not sharing private data. If you have a way to basically store your product data and share it with a wholesaler and everybody else has access to the wholesaler, sees everybody's data. And then when they see, when they scan a product, they look at it. It is all there. Do you have any questions on that?

Magdalena Paula Brück

You know, it is really a lot that I did not know before and that it works like this in the US. It is interesting and I think you explained everything very well and in detail. I do not have any questions.

Mike Hill

Yeah. So that is the first product. Okay. We launched that in 2019, so I think our web site is a good reference for this. If you go you can see it. So, it is our first product is contracted to product verification is the name of that product.

Magdalena Paula Brück

Okay, and the other one is "Contracts & Chargebacks"?

Mike Hill

Yes, exactly. Yeah, product verification was launched last year. "Contracts & Chargebacks" launched this month. So, we just we just launched. We have got a handful of customers that are already adopting it. But this is outside of the supply chain. It is not unrelated to the supply chain. But we sort of classify this as a revenue management process rather than a supply chain process. The implication of both of these is that, as long as companies are exchanging data or transactions, block chain can come in to implement automation and facilitate trust. And I will talk I have some interesting ways to talk about that. I will cover it. But let us only just explain the "Contracts & Chargebacks" process that we implement. So, the let us say a manufacturer sells shipment of drugs for one hundred U.S. dollars to a wholesaler. There is a cost to the wholesale over one hundred dollars. The wholesaler turns around and then sells that shipment of drugs to a pharmacy that they would sell it at something less. So usually they let us say eighty dollars. The reason for that is because pharmacies, there are 80000 pharmacies and hospitals in the US, they actually work through what is called a group purchasing organizations. Essentially, they come together to purchase in bulk. Right. They can lower the price of the drugs that they are purchasing and get a better deal. Those contracts are negotiated between these group purchasing organizations and the manufacturers. So, examples of group purchasing organizations are "Vizient" another one is "Premier". There are other companies like them, but they negotiate the contracts with the manufacturers and the wholesalers essentially need to sell the drugs at those contracted prices. Let us say the wholesaler sells at 80 dollars. Their cost was one hundred dollars. So obviously they have lost money. So, in order to recoup that 20 dollars, they send a chargeback to the manufacturer asking, hey, can you send me the 20 dollars back plus a little bit for my margin. And so, it is sort of the wholesaler's profit is determined after the sale. So they sort of have a contractual

agreement that they will make five percent and then they submit chargebacks after every sale so that they can recoup whatever the difference was between the purchase, the wholesale price and the end price, or their cost and their end price. So, the exciting thing with this solution, so product verification, really the motivator for pharmaceutical companies to adopt it is because they have to because of the law. That is the reason that companies are adopting "Contracts & Chargebacks" is actually pure business value like actual ROI that they can see, and which is really the measure of any successful product. If you can bring in return on a company's investment, you get customers, you scale, you grow. It is very exciting. So, the "Contracts & Chargebacks" has the potential to actually deliver ROI, whereas "Product Verification" is not really so much of an ROI thing. Right. It is not like generating significant value as much as it is helping you keep [...] and safe. It is not, you know, lowering costs or increasing revenue for the pharma companies, it is not delivering value in that way. So, it is exciting, I think, because "Contracts & Chargebacks" is a real product than can actually grow and scale in the way that it does that. Well, before I go before a sort of explain that, does the product make sense?

Magdalena Paula Brück

Yes, it makes sense. What I am thinking, is it easier to forecast the demand for the second product and for the first it is rather difficult, as I understood?

Mike Hill

Meaning demand for the product like Chronicled forecasting, or demand?

Magdalena Paula Brück

Exactly. For you, for your product that you can forecast the demand better than for the first one?

Mike Hill

Yeah. Well, it is interesting. I mean, I think forecasting demand is less of the concern now. Right? We are still a startup. And so, we are just trying to get revenue wherever we can. So, we are not looking at future numbers other than we need to hit this revenue by X date. But I think "Product Verification" does not really deliver... Like, there is not a big price

tag. We are not, like, charging a ton of money for it. The real motivator is that "Product Verification" stuff gets companies onto the network. So, you know, the 20 or 50 companies, I cannot get into specifics about the number of companies that have joined the network. Their "Product Verification" has sort of opened the door to "Contracts & Chargebacks", which actually is a real value-added product. And in terms of bottom line cost and revenue implications. Yeah, so that is sort of the big focus for us.

Magdalena Paula Brück

All right. So, well, I think you answered the first question really in detail. So, your typical clients, as I understand, are like the big what did you say, the big three wholesalers or not?

Mike Hill

Yes, it is each of them. Right. So, in "Contracts & Chargebacks", there are three target customers or typical customers. Right. So, there are only three wholesalers, so you cannot really do anything in the pharma industry without having them, their support. But it is the wholesalers., it is the manufacturers, and then it is also the group purchasing organizations. So "Premier", "Vizient", there is a few others. But again, there is like four or five group purchasing organizations that control maybe 90 percent of the purchasing power in the industry. So that is also sort of a very small number of companies.

Magdalena Paula Brück

Yeah, all right. And in what aspects can your blockchain solution add value to your client's business? Like where precisely do you add the value?

Mike Hill

Yeah, that is a good question. We are actually about to publish a blog post on this. But he (CTO) came up with a really interesting analogy that honestly helped me understand it really well. Think about embassies between countries. So, let us say where are you from originally?

Magdalena Paula Brück

Germany.

Mike Hill

Germany, awesome. So, yeah, the German embassy and the U.S. Embassy. Well, I am going to use it more. Germany, there is not a whole lot of processes for like, you know, you can pretty much go freely between Germany and the U.S. Let me use a company like Nigeria. So, Germany has an embassy in Nigeria, and Nigeria has an embassy in Germany. For a Nigerian citizen to travel to Germany, the German embassy in Nigeria provides, all sorts of requirements so that a Nigerian citizen has to contact the German embassy, get maybe a visa stamped in their passport. They have to get the vaccination is approved. They have to maybe get a letter from the embassy, sort of make sure they get a letter from an employer before they go. So there are all these requirements that the embassy sort of enforces within the country to help make sure that German customs, the German Customs Department, is not overloaded by all sorts of people trying to come into the country from Nigeria do not have their documentation in order, and they have to be processed manually, and there is no follow up phone calls, right? Imagine if nobody had a passport or nobody had the proper clearance before they came. Right. It would be chaos. So, Germany's customs team would have to be five times as large in order to handle this. You know, all this manual crossing processing that would need to be done for all these people coming who do not have the proper documentation. Does that make sense?

Magdalena Paula Brück

Yes, I understand.

Mike Hill

So, the analogy that they used was that essentially what blockchain is and what we are doing is allowing companies to put an IT embassy in their partners system. And so, what it means is when the contract is negotiated between the GPO and the manufacturer, that determines the price that the wholesaler needs to sell. And so but when the GPO and the manufacturer negotiate a price, the wholesaler has an embassy in the manufacturers system, When the contract is signed and it is entered into the manufacturer's system, the wholesalers, the node in the MediLedger node in that manufacturer, sort of acts as an embassy for the wholesalers saying: Okay, this contract needs to have a valid date, it needs

to have a price that is signed off by the GPO, it needs to have all these sort of what we call business rules that the wholesaler has put in place to make sure that when they get their contract data that they need in order to know what price to sell at, it is all valid. So this is where the analogy gets really interesting, because if you compare data and people, imagine today when I send data to companies, there are all sorts of IT, maybe I send a PDF or an e-mail, or I send a transaction, but it is invalid. And so, the point of our product is to eliminate disputes from the chargeback process. Disputes occur because there are delays in sending things, data is incomplete, a contract does not have everything. Maybe a customer that was approved for a contract is not approved in the U.S. government's database. There are all sorts of rules that are required to be followed. And the embassy enforces the rules before the data leaves that companies environment. Before Nigerian citizens travel to Germany, the German embassy helps sort of guarantee that they have all the requirements in place.

Magdalena Paula Brück

All right. That is very well explained, I never thought about it in this way.

Mike Hill

Yeah. I think it is really interesting. So, in this case, so the value going back to your original question I just wanted to explain that in that way, in the chargebacks process, let us say there are a billion chargeback transactions every year. Maybe five percent of those chargebacks that are sent are there is an error. Right. There is some sort of dispute. There is an issue with it. And so that five percent, when you are talking about five hundred billion dollars, that is the revenue almost of the pharmaceutical industry in the US. Then it takes maybe 30 minutes on average to resolve each error and maybe point five percent of the time. The error is not resolved, and it produces like a settlement. Right. Where they have to just sort of say: No, we are not going to agree on who is right and who is wrong. We need to just split the difference and both companies lose money. Sometimes the pharmacy receives, that they have to ask the pharmacy for more money because the price of the wholesaler charge was not enough. Right. So, there are situations like this because of the gaps. So that is where we save money is by enforcing that. You know, every time a contractor sends its shared in real time and it sort of matches all the rules. That we are able

to guarantee that chargebacks are always accurate, which removes disputes. And that is where the value comes.

Magdalena Paula Brück

Another question, when the customers come to you, what attitude do they usually have towards blockchain? Because you said that is by law now, but do you see that the companies want it from themselves actually?

Mike Hill

Right, I think that is a key difference between "Product Verification" and "Contracts & Chargebacks". "Product Verification" it is a law, so every wholesaler and every manufacturer are required to be a part of a verification system where their products can be verified because the law requires it. So, they are essentially evaluating our solution compared to other companies that are also offering verification solutions. And they all need to purchase one solution, but there are various reasons why they choose one over the other. With "Contracts & Chargebacks" it is much more sort of an open field. There is no one else that is doing what we are doing. It is the block chain that creates something that is totally unique and because we were able to get our foot in the door with product verification. We have a much deeper relationship with all of these companies and so the "Contracts & Chargebacks" process that we are doing there. So usually when we talk to a new company, their reaction is one that they have heard of blockchain and they are skeptical because of Bitcoin and other things they have heard in the news. Another reaction might be, where we have our own team that is doing block chain things and there is sort of a pride to it, where we are not going to hand off our block. We have blockchain expertise internally. We are not going to hand it off to you. Sometimes they are sort of focused on blockchain and blockchain is only one part of our products. There is sort of a block chain network where data is shared and sort of perfectly uniform and everybody has access to the ledger that is sort of decentralized. And then we have a peer to peer network that facilitates confidential sharing of information. And the two networks work together so that if I have a chargeback to submit through the secure network, all of my competitors do not see that chargeback and find out what price I am selling, etc. So, we can facilitate private sharing of information while still enforcing that that information is correct through

blockchain. So, companies do sort of really trying to understand, where blockchain is used in this solution and that usually takes a few times to sort of explain the technical mechanics.

Magdalena Paula Brück

Is it usual that they think that blockchain is bitcoin?

Mike Hill

Something like that. I do not know if anybody at this point is that ignorant. I mean, most of the customers we are talking to are pretty intelligent, like they are usually director level of pretty big companies, and so they have a sense, they know that Bitcoin is a currency and that block chain powers Bitcoin. But there is sort of a negative connotation because of the hype around Bitcoin and know a lot of people are debating whether it is a real currency etc. So, yeah, I mean, I think that sometimes comes into play, but we are seeing that less and less now.

Magdalena Paula Brück

Why do you think why some companies actually still do not apply blockchain in their supply chain?

Mike Hill

I mean, one, you need your trading partners to be on the blockchain order to use it. So, you need to be in it and I, I hesitate to use the word blockchain, because I think it is a little like, if you are using a block chain, anything that goes on the block chain is shared with everybody. So a lot of companies, you know, if somebody understands how block chain works, you are immediately not going to be interested in it for your company because it implies that anything you publish to the block chain is automatically shared with all the other companies that are your competitors or your partners. I mean, a lot of value in business is created because you keep your confidential, your private data to yourself. And so, yeah, there is some negative connotations, you know, a lot of people are concerned about privacy. Like, how do you keep my data? How do you protect my data? Or, you know, how can I use block chain if everything I publish is automatically shared with everybody else. So that is usually probably one of the most common questions we get.

Magdalena Paula Brück

Okay, how do you answer on this usually?

Mike Hill

Yeah. Well that is kind of what I was saying before, is that the MediLedger network has to sort of sub networks within it. There is the blockchain network and there is the peer to peer network. So, all business is done on the private peer to peer network, so submitting chargebacks, sending contract information to sending customer data. Everything is done on the secure peer to peer messaging network. So, nothing, no private sensitive data is ever published to the blockchain. What is published to the block chain is what we call a "zero knowledge proof", and this is actually a really, really important concept for you to understand. You should research a "zero knowledge proof". I can explain to you what it is, though.

Magdalena Paula Brück

Okay.

Mike Hill

So, a "zero knowledge proof" is basically proof that something is valid without actually knowing what that something is. So basically, if you think about the group consensus, that blockchain offers, you have multiple nodes that all agree this transaction or this data that was shared is valid and we will accept it onto the block. But instead, the "zero knowledge proof" is accepted onto the blockchain. So, if you looked at the MediLedger network blockchain, you would see a ledger that has a long list of proofs, it is essentially a long string of letters and numbers, a fifty letters and numbers string together. And what that symbolizes is every time data is shared between companies, the business rules, let us say Vizient as a group purchasing organization and a new hospital and they need to add them to their network, that they become a member of Premier so that they can get the discounts that Vizient has negotiated with all the pharmaceutical companies. The pharmaceutical companies need to figure out which contracts that hospital can be applied to. So, if they are buying heart surgery medication or if they are buying skin care creams and things like that. There are all sorts of different medication. The hospital qualifies for different prices

based on the business. There is a whole world of reasons why a certain pharmacy or hospital qualifies for different contracts. But in order to figure out which contracts that they qualify for, the manufacturer needs to know exactly what business they are in, what state they are in, their address. Need to know what identifiers they have for the U.S. government. There are various identifiers that the customer has, so the manufacturer has all these rules that they need. Tell me if I have lost you right away.

Magdalena Paula Brück

No, no, I am listening.

Mike Hill

The reason I am asking is because this took me like months to understand, like, fully. And I mean, I think we are getting a little better at explaining it, but it is a little confusing.

Magdalena Paula Brück

But for me it is really good to understand how you explain it.

Mike Hill

Okay, great. So, the rule that the manufacturer puts in place and says: Hey Vizient, before you send me that hospital, I need to make sure that all the data is correct. So I need to make sure it has to have at least two identifiers, the address needs to be in this format, it has to have a name, it needs to have the business type, whether it is a surgery hospital, whether it is a learning clinic. Now, there is all sorts of identifiers. And those business rules are actually coded into the peer to peer private network. So that customer cannot be sent to manufacturers unless all those business rules are met. And this is, again, the embassy in the GPO Vizient system guarantees all the rules that the manufacturer has put in place for all the data that they received from Vizient. And so, once the business rules are all met and the data is sent, that new customer is sent, then a "zero knowledge proof" sort of identifier, a proof is published to the block chain. A big, long string of letters and numbers. It basically signifies that that transaction met all the business rules and we are good. So that means that Vizient and, have you heard of Pfizer or Genentech? In terms of pharmaceutical companies? What is a pharmaceutical company you've heard of?

Magdalena Paula Brück

I know Pfizer.

Mike Hill

You know Pfizer, perfect.

Magdalena Paula Brück

I mean, I also know Bayer, Beiersdorf, the German ones.

Mike Hill

This is a German company. So, yeah, Bayer sells in the US, it does a lot of business there. So Vizient sends that customer to Bayer and Vizient both know that that customer is valid and that it has all the data that they need and there is never going to be any dispute there because of "zero knowledge proof" exists on the blockchain and so they can go through a record of all the transactions that happened on your network. So, it is like nothing sent through the peer to peer network can be done without registering a proof on the block chain. So the big implication here is actually not with customer data, but when I submit a chargeback, I need to know that everything related to that chargeback as a wholesaler meets all the requirements of the contract that was negotiated. So, it applies to that new hospital, they buy a whole shipment of heart surgery medication. The wholesaler knows that the price that they charge the customer is correct because the contract data was shared with the wholesaler. And there is a "zero knowledge proof" published to the blockchain. So, the wholesaler and the manufacturer are never going to get into an argument over, when the price was signed, what data was updated, when did the program start, was this product discontinued? All the questions that lead to disputes today. That proof on the blockchain means that everything that happens within that peer to peer network is valid. Everybody that sees the proof, does not actually see any data, they just know that all the business that they are doing to peer to peer is secure, but they do not actually see anyone else's data. Does that make sense?

Magdalena Paula Brück

Yes, exactly. That is what I wanted to ask. If the external entities only see the "zero knowledge proof"?

Mike Hill

Exactly, yes. So, the block chain does not share, there is no like business intelligence leakage. Everything is shared directly between Pfizer and Vizient and one of the wholesalers, for example, is called McKesson, so McKesson sells to the pharmacy and they only see what they get from there.

Magdalena Paula Brück

All right, well, that is interesting because I did not know it yet. I want to ask you when you implemented the blockchain for your customers, did you realize or experience any challenges? Yes, which challenges could you observe in the past with the implementation of blockchain?

Mike Hill

Yeah, I think usually it comes around integration with existing systems. And again, I want to go back to us a second to also sort of cover the concept of implementing blockchain, I think it sets a dangerous precedent, because like our solution is not just blockchain. In fact, we refer to it as a network, not a blockchain. So, when we implement the network and a company sets up a node within the network, they are using blockchain, but they are also using the peer to peer network. And then that node has to integrate with an existing system. So, you know, SAP, sort of the 80 percent of the pharmaceutical industry uses as SAP. There is within pharmaceutical manufacturers, they have other systems that manage contracts and revenue related to, the ability to add and remove customers and update customers within those contracts. That is sort of a separate system. So, there is a system called "Model N", there is another one called "Vistex", which are the major sort of what you call revenue management systems in the industry. And so, our solution is plugging in to those. And it is sort of like a smart data pipeline. Before data was coming into model and the sort of revenue management system through some automation. But for the most part, people are manually going in and typing in new customers, changing dates, changing things, there is some internal automation. You know, maybe a product was discontinued and so, "Model N" might be connected to the product management system and it

automatically knows that this product was discontinued. But for the most part, you know, data from partners is manually entered. What we are doing is now creating a smart data pipeline so that when that private, MediLedger node is connected to "Model N" of the customer data, maybe the contract data that is now valid and coming in, it has the same format, the concern of data matches that connects to "Model N" directly. But the challenge to get back to your question is that every company uses a different system. They have different versions. It is sort of creating those linkages where we can plug directly in and we are not competing with any of these companies as we have a sort of UI (User Interface). We have a product that people can log in to, but they are only using it for maybe research and looking at past transactions. But the fundamental data and the contracts are actually stored in the current system. So, we feed that system with the data from partners that is valid. Whereas today it is sort of manual and not valid.

Magdalena Paula Brück

All right. Yeah, it is actually somehow the question I have also for the implementation process. But can you maybe see some differences when you compare companies? Or is the implementation process every single time the same?

Mike Hill

I mean, it is always different. Every company has a different IT set up and their security checks you have to go through sometimes. You know, the IT department has set up all sorts of requirements for any new solution provider to go through that whole process. So, there is like checks and balances and they do extensive testing. So, we have sort of a stage approached where there is a lot of what we call a "launch pad network", which is basically where we host, three nodes that any company can log in to. And we have sample test data in there, and you can set up business rules and you can sort of test out how the solution works. You can send data back and forth to the nodes, when it matches business rules that you set up in that, it goes through, when it does not match the business rules, it does not go through. So, we have this sort of "Launchpad Network". It is kind of like a demo environment, like it is just to help companies understand. And then we have a test network, where the company sets up a node in their system and they run maybe sample data, that they have, through the network and they can do testing with their partners. So, there is this sort of concept where let us say Bayer, Vizient and McKesson are sort of what we call

"dance partners". There is one set of data that is flowing between those three, and that same setup happens between every other company, but those three essentially need to do testing together. So, they are starting this exponential number of test scenarios until most companies in the network have sort of figured it out and new companies can sort of easily plug in and start testing in the future. But today, each set of trading partners has to do a bit of testing itself, so there is some difficulty in launching a new network. You know, like "Contracts & Chargebacks" is just launching now, where every company needs to do testing with every other company because they are sort of essentially linking their systems through the embassies in each of their systems.

Magdalena Paula Brück

And you mentioned the demo and test networks, do you think that is necessary for companies to first have a first glance of how it actually works?

Mike Hill

Oh, yeah. Called the "Launchpad Network".

Magdalena Paula Brück

Exactly. I think you mentioned something with the network that they can experience the features with the partners and get a feeling for it. Did I understand it correctly?

Mike Hill

Yes, so the test network exactly. The test network is where they start testing with partners. So, they would send data back to Vizient, and Vizient would send data back to Bayer, and they would see how it works and test out different rules for how the data is. So, there are all sorts of like initial steps that each company wants to take to make sure everything fits together. And that gets easier over time, as once Bayer establishes all its rules for how things work, any new company that wants to do business with Bayer, and wants to join the metal ledger network, they just take all the stuff of the data and the rules that Bayer has in the test network, and they just start testing their own data against it. Because once Bayer is established, their rules are set. But today, everyone is sort of building their rules from

scratch. There is a lot of more work upfront for every new customer today and that work decreases.

Magdalena Paula Brück

All right, and just in general, I think you know the market of blockchain and its customers, could you experience or observe any changes in the attitude of the customer towards the blockchain over the years? Did it change somehow?

Mike Hill

Not necessarily. And I think that the perception of blockchain is not that important. Like I talked about it a little bit earlier and how companies, some people ask about Bitcoin and the relationship there. But to be honest, I think people get hung up on the word block chain more than they should. It all comes down to dollars and cents. Or, you know, government regulation, there needs to be a business driver to implement something. And if there is no potential for short term value add. Right. I mean, like the only reason that we are able to be successful with "Contracts & Chargebacks" is because we already had some number of companies on the network from "Product Verification". The people only joined the "Product Verification" because of the government regulation. And so, it is sort of this there is the snowball effect where companies are only going to get value from something if other companies are on the network. And let us say even if we only had five companies on the network, there are hundreds of manufacturers, so one wholesaler may still may not implement blockchain, they may not implement the MediLedger network, because they need 15 different manufacturers to be on the network for them, for the wholesaler, to start seeing value. Because if the wholesaler does business with 150 manufacturers and only two or three are on the network, it does not really impact their business. It does not help really in any way. And so, you need this sort of critical mass of companies to be on the network in order to actually create real value. So, it is a tricky thing. And we are lucky to be in a unique situation where "Product Verification" was able to kick start the network and so each company, when they are evaluating "Contracts & Chargebacks", were able to sort of have a base set of companies that are already on the network.

Magdalena Paula Brück

All right, so the snowball effect is actually the driving factor for all businesses, as I understood?

Mike Hill

Well, that is what creates the value. It is like the ROI. That is the most important thing for any company is: Will this generate return on my investment? And it only happens if blockchain and the MediLedger network, if there is a lot of companies already on there. If it was only two or three companies trying to run a pilot, you know, it is not going to go anywhere. I mean it does not matter how well the system works. It does not matter how perfectly it integrates with all their systems. You need many, many companies on the network to create value for every other company. That is just like the social network with Facebook, you need a lot of your friends to be on the network. You just going on, logging on, and talking to two or three of your friends. You might as well just text them for that like it does not do anything.

Magdalena Paula Brück

And from your personal experience how do clients react usually to the changes due to the implementation?

Mike Hill

Well, everything is very custom today. I mean, this is like any traditional enterprise software company. It is not like there is a change today that we are doing that is against the wishes of any one of our customers, because in the grand scheme of things, we are very early and so we basically just give customers whatever they want. I mean, it is not obviously a hundred percent true, but we are not trying to force anything down. A customer's pipeline or, you know, what is against their wishes because we had a scale where, you know, we are trying to make 60 percent of our customers happy, they are happy, but that leaves 40 percent of the customers not happy. Right, and that is when you get to become a large company that is what you do, is you have to make sacrifices because you cannot please everybody. You know what, most enterprise startups are in a place where they cannot please everybody. I do not think you find out those sorts of sacrifices this early and I do not think any company really would. It is just that, you know, the sacrifices and like the changes that somebody might be dissatisfied with do not come until later.

Magdalena Paula Brück

What do you think are good estimators to know if for companies ready to implement new technology? Is it the really the snowball effect that is adding value as you said before? Because what I heard, it was also that maybe the structure of the hierarchy in the company could be a factor for knowing if a blockchain technology is suitable or not? Do you agree or do you have any other points you think could be drivers for no success?

Mike Hill

The hierarchy, I honestly do not think that is as big of a concern or maybe those are not the words I would use. As of the end of the day if a solution creates ROI. If it you know, there is value. Companies will implement it as long as there is proof. Right. That is what makes starting a company very difficult is you need just you do not have proof yet. So, you need to convince companies of the value based on references, you need to sell them a vision of what the value could be. You know, there are all sorts of ways to do that. But I think that one of the challenges is it is not always a sort of dollars and cents logical conversation. There are people's egos, people's reputation, there is past relationships. I mean, it is a very complicated sales process selling. And this is not just for block chain, this is for any enterprise company. When you are selling to a big company, somebody inside that company has to, you know, put their name behind you and say: You know, this is a good solution, it is going to create value. And they have to fight for you internally. They have to, you know, pitch and get approval. And so there is a lot of convincing somebody to sort of trust you is the dollars and cents, ROI is important, but I mean, there are lots of nuance things, as well as your relationship, how you handle issues that arise, how you solve problems, things that do not work. You know, there is all sorts of things.

Magdalena Paula Brück

Do you think that there are like specific industries that actually are "more" ready to apply such technologies? Or do you think that it is not really important which industry we are talking about?

Mike Hill

I think it is actually the only thing that matters. I am actually, to be honest, a little bit skeptical of sort of functional based blockchain companies. Right, so when a company says they are focused on supply chain in general or logistics. To be honest, I think trading partners, like the real value comes from a vertical supply chain. Within the computer industry, you have Lenovo, and ASUS, and Acer, and they have their distributors, and wholesalers, and retailers, similar to the pharmaceutical industry, although they have them all over the world. If they can save money and lower the cost of shipping between, they are between their trading partners by exchanging data back and forth, that is where the big ROI is going to come from. And again, the ROI does not happen unless you have got a lot of companies on the network. If a company is saying, you know, we are doing block chain for the supply chain, without focusing on one specific industry, how are you ever going to get a critical mass of trading partners in that industry? Right, if I have got Lenovo and Acer and two distributors in the computer industry, I have got "General Mills" and "Procter and Gamble", and a couple of distributors in the toy industry. I have got the food industry or, you know, if you are trying to tackle multiple industries, you are never going to be able to... You know, you only have so much time in a day to sell and find new companies and so you are going to burn out before you get enough companies to keep Acer and Lenovo interested. And so, to be honest, that is why we are focusing only on the industry, but like not just supply chains. So, like "Contracts & Chargebacks" processes and the revenue management space, and we are going to be tackling all sorts of other use cases, but all of those use cases, those take place between pharmaceutical manufacturers and pharmaceutical wholesalers. So once you've got those companies on the network, you can keep adding on use cases and you can basically take over and become their entire infrastructure, you can take all of the processes that they do between each other and put it on the network and grow the business without ever adding a new company or going after a new industry. That is the power of it, that companies are on and trading with each other.

Magdalena Paula Brück

So, would you say that the industries where really a lot of different entities are involved are actually the most beneficial?

Mike Hill

Yes, so it is exactly the same as like Facebook, right? Social networking, a college campus, if your friends are not on it, it is not valuable, and the more friends that are on it, the more valuable. You can see your entire social network online and scroll through your news feed and see what all your friends are doing. You would be on it every day, that is what everyone does today, everyone is on social media. But you cannot get all your friends on the social network, if Facebook is focused on, you know, selling to everybody in the world and it would not start on one college campus. So, they get everybody on that college campus onto the network and then then it is valuable. Then it is exciting. So, I just do not think in enterprise sales you can focus on more than one industry and in the end be successful. I just I think it is impossible.

Magdalena Paula Brück

And do you think that there is any industry that really needs the blockchain technology?

Mike Hill

I mean, I do not think that there is a one industry needs it over the other. The value add is so obvious that whenever one company is doing that, it is like any vertical supply chain. So, auto manufacturing, Toyota and Ford and Volkswagen all have manufacturers, they have distributors, they have retailers at every point in the supply chain. Companies are sending data back and forth, this specification data is incorrect, it is sent late, it is invalid, and all of those anytime data is incorrect or delayed, it creates loss for the other company. And so, you get this sort of compounding effect where if everything is correct and sent real time, you get value at any stage. So, yeah, I do not know if there is a need in one industry over another, it is just a question if you have got to find the right people that have the right relationships to bring, you know, 50 companies on at the same time. It does not really work if you talk to one company and then another and then another. And then two years later, you have got five companies and they all give up because there are not enough companies. And you run out of funding.

Magdalena Paula Brück

I would go no more to supply chain and supply chain collaboration a little bit. And could you tell me why trust is so important for the collaboration?

Mike Hill

To be honest, we use the word trust a lot but there is no like change of behavior that we are expecting. We are not expecting anybody to start trusting people. The hourly rate block chain enables trust because block chain acts as sort of an automatic judicial system. The block chain is the judge, the jury, and so today, if the in chargeback's process, if McKesson and Bayer are in a dispute and there are 10 million dollars on the line for a large shipment that was sent to a hospital system. They dispute it, they argue back and forth, there is a sort of that debate on when the date that a certain documentation was sent. Maybe the documentation was inaccurate and eventually they cannot resolve it. So, they have to go to court and the judge resolves the dispute and agrees that this X payment is due, and it is resolved. Right, this whole process that companies have to go through if they want to resolve disputes [...] And if you think about the whole traditional system that is meant to resolve disputes, that all occurs because it is always a he said she said thing, it's always one side has one point of view one side has the other. And there is no sort of immutable record or, you know, decentralized ledger that can sort of prove which side was correct at any given time. And so that is really the power of blockchain, it is decentralized, it is an automatic judge and jury, and it automatically has a record of everything and so you always know who was right and who was wrong. And so, you are sort of forcing trust between trading partners. Which is where it would be great if everybody could trust each other, but they cannot, and so they do not. That is what leads to all the issues, and blockchain actually makes trust possible. But like, it codifies trust. So, trust is not honestly that important. It just means that, you know, I no longer need to go to court to resolve disputes. I can just depend on the block chain and so because I can trust transactions on the blockchain, I can trust my trading partners because of the blockchain.

Magdalena Paula Brück

All right, and I am focusing a bit on the trust issue that is actually between collaborators. And therefore I just wanted to know if you can think of any other problem in the collaboration between the partners, like interpersonal, if you could think there of any other problem that could occur and how the blockchain really could add value there?

Mike Hill

Well, there is problems in every use case, so like we have a road map, so we started with "Product Verification", then we have now moved on to pharmaceutical "Contracts & Chargebacks", we are then moving into medical, surgical "Contracts & Chargebacks". Then we are going to move into rebate management and government pricing. So, each of these sort of use cases has different data sent and so you need different rules in place in order to facilitate that data being sent. The transactions that happen between companies look different, and so each use case has its own problems that are there all relates to the same problem that you cannot enforce you are trading partners to always do things exactly the way you want them to be done. And so, you always have to have a team of people in manually processing incoming data and transactions and reconciling and making sure that everything lines up. So that the problems are the same in every use case. It is just a question of adding on use cases. Like I said before, you know, the we have got wholesalers and manufacturers and a network all the different ways that those companies interact with each other are the use cases that we can solve. But all those use cases have the same problems that companies send data that nobody can control how other companies act.

Magdalena Paula Brück

So, the problems in the collaborations are maybe rather the regulations and that everything has to be done manually, and this can be solved by the technology?

Mike Hill

Yeah, yeah.

Magdalena Paula Brück

All right.

Mike Hill

Yeah, I think that is it.

Magdalena Paula Brück

Perfect. I think we come now to the last part. How do you expect the supply chain to change in the near future and also in 10 years?

Mike Hill

How do I expect the supply chain to change? I do not know if I have anything new to contribute there. I mean, I think if everyone is using the MediLedger network, you get all the sort of automation that that enables. And so, yeah, I think it is just everything I've already said that guys can automatically do business together and control what happens and what they receive from their trading partners.

Magdalena Paula Brück

Do you think that there could be more regulations by law given that you really have to make the traceability and trackability of assets more transparent?

Mike Hill

I do. I mean, this law is encompassing. So, yeah, I would definitely look into it more. I do not know if there are new regulations that are going to happen or are needed. This law pretty much requires everything. Not to say that this law does require block chain or technology like that, it requires, you know, something that blockchain is a very good solution for. But there are other ways to do it. So, it is not like an obvious done deal that the entire industry is going to adopt blockchain. But the implications today and the companies already participating... There is a trend already in place.

Magdalena Paula Brück

All right. And can you think of any limitations regarding the blockchain?

Mike Hill

Limitations. Yeah, the MediLedger node that allows the company to connect to the peer to peer network and the blockchain network. Like Chronicled has no control over that node, we do not have any access to it, it lives inside the company's infrastructure. It is not something we have any control over. We send out software updates for the network and

for the software, and it is up to the company whether they want to implement them. And so, because every company runs their own node and has their own software. The blockchain itself is dispersed, so once it has been sort of deployed and is in production, there is no going back. So, if for example, sensitive data is accidentally published to the blockchain, it can never be removed. Right, like the blockchain is immutable proof, nobody can change it. I mean, with Bitcoin you read all about these like 50 percent attacks, like what you could talk to control the network. But to be honest when something is on there, though, it cannot be taken away. You can have a correction posted which says, you know, this was published then, and it was taken down. But you can always go back in. That is not necessarily a downside, but, well, as we are getting started, there is a lot of time and energy and investment going into making sure that there are many, many different checks and balances in place to prevent the chance of anybody posting anything that might be deemed as confidential or is not supposed to be published. Right, so there is a downside there. The benefits of blockchain mean that there is a risk that nothing there is not a lot of corrective action that can be done on a permanent basis.

Magdalena Paula Brück

So, we reached the end. Do you have any other point that you would like to add where you think it is actually important to mention?

Mike Hill

Yeah, I think the concept of working groups, this is something that has been around for many generations of companies. When companies need to do business together, there is a general process of companies coming together and figuring out how to interact with each other. So, payments around the world, there is a network called Swift. If you look at just "Swift Financial Services", it was started in 70, 80 years ago, a long time ago, where banks, all the banks in the world realized that they needed to be able to facilitate payments between each other on behalf of their clients. So if Chronicled sends a payment to Bayer or Bayer sends a payment to Chronicled from Germany to the US, the German bank and the U.S. bank need to know how to have that data be valid and matched so that both systems can receive the data. They do not have to have a person sitting there receiving every payment and codifying it into that bank's system because they have different formats and rules, etc. So, there is this sort of fundamental idea of a working group that has been around

a while. But in the past, it was always about just standards. It is just saying when we send bank transactions, they are always going to have the customer's name, the customer's address in this format, they are going to have the amounts, the date, etc. And so, the banks all came together 70 years ago and said, we agree on this format. It is sort of a down pipeline that basically allows the transaction to go through, but there is no control in place. So, if a transaction comes through and it does not have the correct address, then then the bank representative has to go through and fix the address before it can be sent into the bank's system. So, there is so there is no, like, controls that it can impose on the banks. It is sort of more or less a set of standards. With blockchain what is happening is, these working groups that used to just figure out standards, they are now actually building products. So, we started in 2017, a working group within the pharmaceutical industry to figure out how block change could be applied to the "Drug Supply Chain Security Act". And that working group was maybe six or seven pharmaceutical manufacturers, wholesalers that all came together and that working group essentially developed the requirements not just for the standards, for like how they want to do business together, but like they developed the product requirements for building the full solution. Not like they developed the need for privacy. They developed the need for zero knowledge proofs and forward the sort of separation of the peer to peer network and the blockchain network. So, every new use case built using the middle ledger network is going to require sort of a working group. And I mean, we have a supply chain working group and a revenue management working group. And again, if you go to our Web site page, you can scroll down and see it. But the members of the working group essentially work together to figure out how they want to do business. And then we codify that into a product. So, it is sort of collaborative product development, if you will. Like most companies need to get feedback from their customers, but this is a situation where we actually cannot build the product without, you know, companies agreeing on it because the product is the mechanism by which companies work together. So, I cannot build a product and then have a separate conversation with Bayer and a separate conversation with McKesson because, you know, McKesson and Bayer might have different opinions and that does not work for us. We need Bayer and McKesson to have the exact same opinion. So, we need Bayer and McKesson to be in the same room, both giving feedback at the same time and agreeing on a uniform feedback. So, we build the product that works for both companies. And we do that with every pairing, so we have seven or eight companies that have joined in that. Now it has expanded, we have, I think, 15 different companies and partners in the working group now.

And that does not include every customer, but we need, you know, a sample size. We need four or five manufacturers that all can give opinions on: What is a manufacturer are going to agree to, and what is McKesson and Cardinal Health and the other wholesalers, what are they going to agree to? And so that collaborative product development is essential here. We cannot have siloed customer feedback conversations. They need to give feedback to you.

Magdalena Paula Brück

Perfect. I did not hear this yet, that is something new. Thank you.

Mike Hill

I mean, I think that is the situation of the industry point I was talking about before. Because the real the real value from blockchain comes from automating processes between companies that do business together. And so, you need to find as many companies as possible that are all doing business with each other in the same supply chain, in the same industry. And then when you do you bring them together. That is where the value comes from, is that they all agree on how they want to do business together and they can build it into a product.

Magdalena Paula Brück

All right, great. Thank you, it was very helpful.

Mike Hill

If you want any feedback or having other questions, just let me know.

Magdalena Paula Brück

Thank you so much. Goodbye.

Interview 3 – T-Mining

Magdalena Paula Brück

Let us start with the questions.

Christiaan Sluijs

Yeah, let us go ahead.

Magdalena Paula Brück

How does your company apply blockchain itself?

Christiaan Sluijs

Well, that is a good question. We do not apply it ourselves because we are not a real technology provider, so we do not have any operational business other than making software. So, for that, you do not need blockchain technology. Well, we rather prefer talking about decentralized technologies because blockchain is basically very well known, but talk more about decentralized technologies because we do not only use blockchain because there are lot of decentralized technologies, but actually the idea behind is the same. It is actually like the name says, it is decentralized, or it is not centralized like a cloud solution, which is clearly centralized. If you look to let us say Facebook and we all know it is centralized. And so, it means that one entity sets the rules of the game and makes the business logic and basically depends on the party. In a decentralized environment if you talk about a kind of a network where people participate, there is no one and no one can switch it off. So, you do not have one central authority. And that is exactly what we do, supply chains are quite interesting to do by decentralized technologies, because typically in a supply chain, you have a lot of parties that are involved. So, what we do is we provide software solutions, software applications specifically for supply chains. That is basically what we do, and we have couple of use cases now of which one of them is already in production. And so I think, we are among the very few launching applications that also run in production and really have a daily usage because some of the blockchain platforms are maybe in production, but if you ask how many transactions you have, then there is not a lot of use. So, what we do is we provide software that can be used or that is used even in decentralized networks.

Magdalena Paula Brück

And how do you offer the blockchain precisely like which solution, application or technology is it like tracking or smart contract? Where do you specialize?

Christiaan Sluijs

Yes, well, basically you have two typical things you can do with the blockchain. So, you have tokenization which basically looks like Bitcoin where you tokenize money, you can basically tokenize a lot of things. Mostly things that come with a certain value or things that you want to be scarce, like the right to pick up the container, documents, typically, you do not want to have endless copies of documents, so you want to be able to proof that you have the original documents or authentic document another copy that has not been tampered with or manipulated. So that is what we call tokenization that you are able to transfer something, while in the end duplicating something. If I send you an e-mail, it is just about duplication of data, I still have my original e-mail in my sent items, so I just sent you a copy. But of course, if I want to send you a document, it is very difficult today that because what is the original document? So that is tokenization. It is also about timestamping it. So, we also have use cases that really define on timestamping. You want to be sure that, for instance, a document has been created at a certain time. Maybe you want to register a certain event. So, we are working in the port of Rotterdam on a project that is about timestamping of certain events. Typically, a related port calls so if a ship enters the port there are a level of activities. And basically, what we do, we register all these activities in blockchain, so we can avoid that there are disputes later on. We find a kind of a common consensus of common truth about what has occurred during a certain port call. So that is timestamping, so registering facts, typically validated by different parties. So, an agreement in the sense that a certain fact as has occurred. And so, then you write that in the blockchain. So basically, it is the notarization function of blockchain. And these are two typical use cases, a third different use case has basically to do with data sharing. Like I said, if you want to share data, you can do it in a centralized environment, look to Facebook. It is basically an application where you can share a lot of data, but you always share your data with Mark Zuckerberg. And, in a B2B environment, you maybe want to share data, but not with a party that is overseeing all your transactions. So, what we call commercial privacy, you cannot really make that in a cloud environment because

it is always a cloud that is hosting your data. If you really want to have full privacy, you cannot use a cloud because there is always someone hosting your data and making copy of that. So that is why we use decentralized technology to share data peer to peer. And so, on the need to know basis. So, it is not shared with a third party it is just A and B wants to share certain data. They can do that amongst them that all the parties in the network like C and D will never see that data. They only see the hash on the block chain, so you can always verify if you receive certain data that that data is authentic, so the notarization function of. But you cannot see the underlying data itself because that data is not stored in blockchain, but we exchange that B2B. We exchange it like, BitTorrent, it is the technology that is used to for the dark web, so illegal copies of movies are shared B2B, so there is no central database available. We do a similar thing, but of course not on a dark web but in a B2B context.

Magdalena Paula Brück

All right, and you answered already a second question. But what are the typical clients with whom you work, like the industry, the company size, and which regions?

Christiaan Sluijs

If you have to secure container release which is actually the best use case that we do today, and we are talking about carriers. These are typically, the owner of the ship, or if you look at the big container ships, they are operated by companies like Maersk or MSC which are actually the biggest carriers. And MSC is one of our customers today. I mean, we also work with freight forwarders. So basically, the travel agency of the containers, that is called freight forwarder. So, they arrange all the administrative booking processes to make sure that the transport happens. Of course, transport companies and terminal operators are basically the ones that operate the physical terminal at the port, loading and unloading a ship. So, these are amongst our customers.

Magdalena Paula Brück

All right. And in what aspects can your blockchain solution add value to your client's business?

Christiaan Sluijs

Well, if they need to collaborate. So blockchain is about working together between those different entities that, like I said, so the carrier wants to collaborate with freight forwarder. They want to collaborate with transport companies and transport companies want to collaborate with terminals. Basically, a lot of parties are involved. So, it is about how you organize that collaboration without having a central entity that oversees all the transactions. Now, the fact that you have a central database, that can be manipulated, because actually every database as an admin and he or she can change the date that is in there. So, you are never sure about if data is really authentic. So that basically are the use cases that we do. So, in case that companies want to work together and you might need blockchain.

Magdalena Paula Brück

Okay, and in the beginning, which attitude did your customers have towards blockchain technology?

Christiaan Sluijs

That is a bit of a difficult question. I think in the early days, like when we started the company in 2016 /17, blockchain was really a press word, everyone was looking at blockchain: Wow it can change the world and you operate in your business with smart contract. They were a little inflated expectation. A bit like AI a couple of years ago, so some of the customers were just looking in on a press release, mentioning the word blockchain, and the company name. But that was something that we did not really want to consider. We really wanted to look into use cases where we can find added value or just using blockchain for the safety. And so, we came up with three different cases, secure container release, which is actually about transferring the right to pick up a container at between carrier, freight forwarder, the terminal operator and the transport company. So, it is really about tokenization of rights. We do also have a project on documents like phytosanitary documents that typically come with importing apples or other fruit or vegetables that come from different countries. We also have a product running on certificates of origin that come typically with training goods, you need to prove the origin of specific goods. So that is basically on the document flow. So secure container release, is on the physical flow, secure document workflow is on the documents flow. And then you also have a kind of a hybrid model where we are talking about registering the statement

of facts, which is about registering certain events on the blockchain. So basically, three use cases that we work today.

Magdalena Paula Brück

All right. That is interesting. And which reasons can you usually identify that explain why companies until now do not apply the blockchain in their supply chain collaboration?

Christiaan Sluijs

Well, it is, of course, a new technology and people are looking into ways how they can start using that. Typically, if you look to cloud technology, it is really a solution that I can use, but it is not designed to collaborate. I can probably work on my cloud environment, but there is no need of a third party option. Blockchain does not make any sense if there are no other parties involved. So, it is really about collaboration. And that is something new because there is a nice article, I think it McKinsey wrote it a couple of years ago and it is called "The Competition Paradox". Where you can see that companies need to work together. For years they have been competitors and now they see benefits of working together. And so they need to have kind of a common interface, a common tool to do that, because it is typically what we've seen is that in the 90s and also [...], we have seen a lot of companies using all kind of web applications where they ask then if you want to work together with me, and you can have a web app and you can just shoot me your data in my web app and then I have an automated system behind it. And now blockchain is about interconnecting all those systems, the back-end technology allows you to integrate your system with the system of a competitor. You know, basically building a centralized platform.

Magdalena Paula Brück

All right. Which challenges could you observe in the past with the implementation of the blockchain?

Christiaan Sluijs

Yes, well, it is decentralized, so it means that you really need to be physically installing software on a device that is managed or hosted by a third party. It is not in the cloud, so it is less scalable than typically a cloud solution. If you are using Google, it is a cloud

solution, so we do not install anything on your PC. With blockchain or with decentralized technologies you really need to install software on your own device and that is definitely in bigger companies a challenge because everything is cyber secure within firewalls, it is all very well protected and there are a lot of procedures you need to follow to be able to install something on your PC or on the server. So, it is quite complicated, we have seen quite some challenges doing that. For instance, for the solution that we are running today in production, you need to install a wallet and a wallet is actually a piece of software that is running on your laptop or on your server, and it basically contains the public and private keeper, so it is basically your credential. Like if you log in to Google and you need to key in your username and password, of course, Google stores those passwords on a central database. And so, from time to time, you are reading a newspaper that the application has been hacked and that millions of people have been exposed and credentials have been stored on the dark web. That is because of all those passwords that are stored in one central database. But typically, we do not store any passwords of any new users of our systems, so that is more secure because if there is a hack, they only get the credentials of that party and so not of all the users of the system. But, of course, that is a bit of a hassle, so you need to install it locally and not everyone is that tech-savvy or has outsourced that part of the IT security, so then you need to contact that party. That is a bit of a challenge. Other than that, there is not really a complication. Like I said, of course you need to have a kind of a coalition or you need to have a consortium that wants to adopt. Of course, you can perfectly use Google Drive on your own, but of course, our blockchain solution, is just really about working together. So, you can basically compare it with WhatsApp or Facebook. If you are just the only one using WhatsApp, you will not have a great time using the application, it is the same for our system. It is really about network effects.

Magdalena Paula Brück

All right. And do you see some differences in the implementation process of different companies?

Christiaan Sluijs

Well, no, actually what we require is a common standard, so you need to run a specific piece of software that we provide. So right it depends on your policy, but it is something that has been developed by us that you can run on your local machine. Of course, there are different ways of implementing blockchain, I think that is the question that you want to

refer to, and so of course it needs to be decentralized, which means that there is no central server where the application is running. So, you need a lot of parties that run a different node, but you cannot expect from everyone to run a node. For instance, a truck driver that is working on its own might not even have a PC. So, if you are asked to run a node in the network, he will maybe answer very politely but will say no thanks. So basically, there we have a solution with our web application and even a mobile app, where typically those parties can take part to the network without running a node themselves. So it depends, we have a web application, we also have an API version where companies, bigger companies can integrate the API because they are not really interested in a Web application, because they want to have fully automated system. So, it really depends on who is using your application. But of course, they all can work together. A big terminal can run a node and work with a very small trucker. The setup for both is different because the trucker might be using just a single mobile app and that can be perfectly combined with a terminal that is fully integrated in the API.

Magdalena Paula Brück

Do you have to explain a lot when the trucker only uses the mobile app? Do you have to implement and explain a lot to this person?

Christiaan Sluijs

Well, not really. If you talk about using the Web apps or mobile app, it is quite self-explaining and basically it is about the UI and the most of that is self-explaining. But if you are talking about how to integrate your API connection or how to install the wallet on your local machine, of course, then we have all kind of documentation that is basically similar to any kind of B2B application where you have documentation for how to do that integration or the installation. Of course, we make it user friendly and we do not expose any blockchain complexity to our end-customers because that is not what they are looking for. And so basically, our software is about making sure that they do not touch the blockchain directly. So, we take that complexity for them.

Magdalena Paula Brück

All right. And how did the interest of companies in blockchain change throughout the years?

Christiaan Sluijs

Yeah, like I said, it had been very popular because of the hype on blockchain and Bitcoin. And people thought that there were all kinds of possibilities to make money and that of course, has to do with Bitcoin and the cryptocurrency mania that luckily has gone now. So now you see more and more people that really think on how they can use blockchain. So, within use cases that are quite interesting in terms of that people want to replace paper flows into digitizing. So, it is basically converting a paper document into a digital document. Most of the time, you do not need blockchain for that, but for some use cases you might consider blockchain. Sometimes a pity was that people were thinking of the document like the documents still from the paper document, and so they really wanted to see a PDF, which is not machine readable. It is not really interesting from a technology point of view. In contrast to have a PDF it is way more interesting to have an XML file or a machine-readable file. But you still see that people really want to go back to the paper documents just to understand what is going on from a technical perspective. So that is a bit of a disappointment because then of course, you do not really fully use the potential of something digital because a document is just some information and information can be much more efficiently processed if it is not on paper or not in a document. And typically, also on a document there is a stamp, but you do not need to prove that something has been authorized by a third authority. So now we see that for instance in secure container releases, that which is really about the tokenization of the right to do something. Ten years ago, that right was expressed in a document. That document has been replaced by PIN codes. The problem with a PIN code was that it could be copied very easily. And so, it is not really cyber secure. So, we replace it by a blockchain token and now you come to a process that is far more interesting than the paper document like 10 years ago. So that is, I think, a bit of what we see the evolution in the market of blockchain. So, I think people are more and more understanding. It is more about understanding the digital form, because typically what people do now is, they want to digitize the paper flow like it has been for 300 years but doing it now digitally. But most of the time it does not make really sense to just digitize that paper process, you can redesign the process completely. And there you coming to very interesting use cases like what we are doing now in the port of Rotterdam, where they want to replace all the documents. The typical statement of facts and that proof that something has happened. They just want to do this by a timestamp in blockchain.

Magdalena Paula Brück

Okay. So, the companies want to get away from the traditional, but the fear of the unknown often stops them as I understand?

Christiaan Sluijs

That is not only the fear of the unknown, but it is maybe also the fact that they are so sticking to the old way of working day, they stick to the paper document flow that has been there for hundreds of years. And like, if you are looking to the bill of lading, it is a document that has a history of more than 300 years. So of course, you can change that document flow dramatically, because now we see a lot of entities a lot of parties. But you do not need that sequence from the people to flow anymore. So, you can do it and make it a little more efficiently. It is not about the unknown, it is really about trying to think out of the box. Yeah, they are they are sticking to their traditions and their old way of working and they want to keep as much as possible. So, we want to digitize the existing process rather than reengineer to make it more efficient.

Magdalena Paula Brück

All right. And from your personal experience, how do clients react to the changes with blockchain during or after the implementation?

Christiaan Sluijs

Well, I think most of the time they are quite satisfied because of course we solve the problem. And of course, they do not really see the blockchain, they are happy that their problem is solved, but also, they sometimes do not really understand it because blockchain is back-end technology. In the user interface, you cannot see that there is blocking behind it. So, it is sometimes a bit of mixed feeling because like I said, it is back-end technology, so from the user interface you do not see the blockchain, you do not know the difference. That is sometimes a bit of a mixed feeling, let us say.

Magdalena Paula Brück

OK. All right, and what do you think are good estimators indicating whether a firm is ready and interested in blockchain or not?

Christiaan Sluijs

Can you repeat the question?

Magdalena Paula Brück

Of course. Can you identify estimators that show you if a company is ready for the blockchain and really benefits or if there are on the opposite estimators that show you: This company is not ready at all?

Christiaan Sluijs

It depends a bit because like I said, we are now in production, with secure container release. I guess that a lot of companies that are using our application, they are not aware that they are using blockchain technology, they are just using the application. But, of course, that is really a product, so they are using a service and they are no longer aware about the underlying technology, just like using Google Drive. But we clearly see that we also do a couple of projects with companies and they all come to us. They ask very specifically, can you help us with this, can you build a prototype, and we can see then. It is not that we can measure the readiness for blockchain because they come to us and they ask, can you help us? So, most of the companies we are talking to are very early adopters, they are innovators, not even early adopters. Really pioneers and innovators, asking us: Can you help us on redesigning our way of working. So, it is quite difficult to answer that question because we do not talk to companies, they come to us.

Magdalena Paula Brück

All right, and can you think of any reason for a not successful implementation?

Christiaan Sluijs

Yeah, of course. I think what you typically see and you see a lot of use cases today that make huge announcements and it sounds very promising, but basically very often we see that actually they do not need blockchain or we do not understand why they use blockchain. Just because they want to show off or they want to show that they are innovative. So very often a failure of blockchain project is about the fact that they have chosen the wrong use case that they do not need blockchain technology. Secondly, it is also because of the fact that it is a very still a very nascent technology, an early stage technology. So, it is quite difficult to get it working properly, although there is a lot going on and it goes very fast, it takes much more time to make a blockchain application than a cloud-based application. It is quite challenging, so the technology is not at the same level as typical ones.

Magdalena Paula Brück

Okay, it is at the first stages. Are there industries that are especially ready for a block chain because you have said that some are actually not ready or they misuse it, but are there really industries where you would say: They are especially ready?

Christiaan Sluijs

Yeah, it is difficult to compare industries because we are focused on the supply chain and we are not focused on other industries. Typically, you see that the banking industry is adopting blockchain for a couple of years already. So, it is difficult to say and to compare industries. But I think, we see supply chain quite interesting because of the fact that there are so many parties that need to collaborate.

Magdalena Paula Brück

Can you tell me why trust is so important in the collaboration?

Christiaan Sluijs

It is a bit of a difficult concept to grasp. And what is trust exactly? I always compare it with money. So, we all use paper money because we think it has a certain value, but it is actually not. I mean, if you just take a piece of 20 euros, it is worth anything. It is that trust. So, there is kind of a technical perspective. And there is also a business perspective for where you need to trust the third party. And so blockchain basically solves that if you want to transfer something, you do not need a third party that settles the transaction, so typically in Bitcoin you do not need a bank, there is no third party that settles your transaction. So, some people think Bitcoin is the third party. They are right, they use a certain transaction fee. But there is no man in the middle that sets the rule of the game. So, help me again?

Magdalena Paula Brück

It was about the question why trust is important in the collaboration.

Christiaan Sluijs

Yeah, exactly. I think there are a lot of aspects of trust there. Like I said, we focus a lot on commercial privacy, you want to be able to share sensitive data only if you can really be sure that your data is not shared with a third party if it cannot be monitored, if it cannot be

tampered with. So, in a centralized cloud it is very difficult because there is no guarantee that data that is in there has not been changed. That is just the way how a database works, there is no record on what has been changed. So, they can just change everything that is in the database so that there is no projection of that. And there is always someone that has the right to change your database, so do not think that you cannot change a database, it is always possible to change that. So, trust is basically here because of the fact that you decentralize something, you make it far more difficult to hack it, to cheat, to tamper data. So basically, you can more rely on the technology. That is, I think why trust is so important and why blockchain is more trustful than other technologies. So, I think that basically is the answer to the question, but it is very difficult to really grasp the idea of trust.

Magdalena Paula Brück

Of what reasons for trust issues between collaborators can you think?

Christiaan Sluijs

Yeah. Well, I think one of the very nice use cases that we have done for a trading insurance company is that they are issuing bonds and a bond is proof that you are insured. So, of course, that trading insurance company is making a bond that you are insured for let us say one million euros, and so your trade is insured for one million euro. Of course, if I am receiving that bond, I have an incentive to cheat, to fake that bond, maybe I want to extend the validity date, maybe I just want to increase the amount, I do not want one million, but I want the insurance for five million. So, I just edit the PDF and it is quite easy to do so. So typically, in the flow is that I get the bond, I can prove that I am insured, I give it to you, then you get the bond that proves that I am insured. But how are you sure that I did not cheat with the bond? You do not know; you do not have proof. So maybe you will find something strange on the bond, maybe you see something that shows that I have been cheating, but you are never sure. So, you do not see that that something is trustful. We have made an application for that, you can basically register the bond in blockchain and once you get that bond physically, you can validate it in blockchain. And so basically what you would do is to compare the hash that you have with the hash that has been originally stored in document, in the blockchain, if it is the same, you know that you have an authentic real bond. If it is not the same, then you know that you have a fake bond. That basically solves a very basic question. I have a document how I am sure that it has not been tampered with.

Magdalena Paula Brück

So, in technical terms, the hash validation is one solution for the trust issue?

Christiaan Sluijs

Yes, exactly. And exactly the thing with the notarization, you have a timestamp and you notarize that hash. So, you are assured that you can compare the original document with the document you have. The same with the transfer tokenization function, if you want to make something scarce, of course, you do not want to have money scarce, so you do not want to have a double-spending. If you get the Bitcoin from someone, you want to be sure that that Bitcoin and cannot be double spent, because otherwise you order, you are getting something that has no value. So, these are basically the two elements where blockchain really can ensure trust. Not that I must trust the bank, I can trust the technology. That is the idea behind it.

Magdalena Paula Brück

OK, perfect. And can you think of further problems regarding the collaboration between partners?

Christiaan Sluijs

Of course, technically, because you need to work together. So they are some challenges on that. Like I said that you need to install locally, you will need to run a node. There are some limitations with that, it is easier to use a cloud than a blockchain. Yeah, I cannot really think of any major issue.

Magdalena Paula Brück

Maybe it can also be the human factor between the collaboration partners?

Christiaan Sluijs

How do you mean?

Magdalena Paula Brück

That the relationship is not only on the business-related part, which can be solved by technology, but maybe that there is also an issue regarding the human factor, like the personal relationship. I think maybe it is about the sympathy between partners that can

have an effect on the supply chain performance and maybe it can be indirectly solved by the blockchain because the contact, the physical contact is reduced.

Christiaan Sluijs

I am not really sure about that. Typically, what you see now is that you have a lot of reconsolidation problems, you have a lot of disputes because typically everyone has his own version of the truth. Basically, what you see, if you have 10 parties involved in the supply chain, they all have their own database. Of course, they put a lot of effort in synchronizing the information that is in that database, so there will always be mismatches, it will never be synchronized. Basically, what we are trying to solve are the discrepancies, the inconsistencies in that data set, because it is quite strange. If you think from an outside perspective that if you have 10 companies working together, that they are all using different software and actually the same, because if you want to move a container from A to B, of course, it is just the same data. It is the same container number and the same stuff that is in there. So, you want to reuse that data. What we really see today is that everyone has his own SAP system, or everyone has his own ERP system. Typically, those ERP systems do not talk to each other, so they it is all about data silos. What we actually do is we try to interconnect those data silos, that is exactly what blockchain wants to do. It is the way how we design our solutions; it is really about interconnecting those data silos.

Magdalena Paula Brück

And did you experience that the relationship between supply chain partners changed with the adoption of the technology, or could not you precisely experience and observe this?

Christiaan Sluijs

No, well, not yet. I think that is maybe too early. But what we expect is that some of the business models that you typically see today will change. Today people say blockchain will get out the middleman. We do not really see that. By the way, a lot of people were saying, blockchain will cut out freight forwarders because freight forwarder is basically a travel agency. And you know what has happened with the travel agencies in the B2C World, they have been all replaced by Booking.com. Blockchain will be the next wave of disruption for these types of middlemen. Yeah, because typically what you see is that already cloud solutions are replacing that type of middleman. What we basically see is that, for instance, one of our customers in the Netherlands is really working on that and they

really want to reengineer their business model. So, they came to us and they say: Well, we very focused on the analog world and we do the paperwork, we sit in between partners, we do the coordination. But actually, if you look at our business model, from a digital perspective, we can be a platform, we can be a kind of a Booking.com platform which basically matches supply and demand. And that is a whole different way of looking at their business than what they are doing today as an intermediary. It is really about reinventing your business model and all really have very clear thoughts on that, saying, if we just continue on buying services, adding a surcharge on that and selling that to our customer, we most likely will be disappeared within 10 or 20 years. And so, they really have ideas on how to digitize that in a kind of a decentralized platform. So that is not something that is about to happen right now. What you typically see is that digitization is about saving the stamp, which is on the paper document, so it is a phase where we are now that people want to reduce costs related to printing of paper, they save the courier, they want the state the stamp that is on the documents. That is basically the change that people are realizing today. We see that there will be some changes in business models over the next 30 years.

Magdalena Paula Brück

I think, you answered the next question was, how do you expect the supply chain to change in the near future, and in the long term? But I think you perfectly answered this. And of what limitations for blockchain can you think?

Christiaan Sluijs

Well, you have technical limitations, like scalability. So if you just purely looking to blockchain and blockchain is not a scalable solution, it means that if you add a node that it does not create more capacity on the blockchain it is just an additional node that will be synchronized. So, it is not scalable, so you have to take care and do not put too much data that is not needed there because it would just make your blockchain life visible. So that is, I think, technical. But I think you already know what might be a challenge within like five to ten years' time, is that today's business models are really oriented towards centralized services, like you are looking to SaaS business models. This is what it is really like, I buy a SaaS solution and I just pay for a monthly subscription like 10 euros a month, or I pay for a specific transaction. I pay two euros and I get 100 gigabytes on Google Drive. That is just a way of doing business on a SaaS way. When you are talking about blockchain, the question is like, how you can validate, how you can monetize that network. Because it is

not owned by Google, it is not owned by Facebook. So how do you make that work, how do you make money? And so there we see some issue in the interest in ID (identification), that might be a limitation, but also an opportunity because today the traditional business models will not be very suitable for blockchain in the long-term.

Magdalena Paula Brück

And can you imagine any aspect how the blockchain could affect the company negatively?

Christiaan Sluijs

That is not the idea. That is not what we want to be thinking, we want to see the upside, we do not see the downside. No, I seriously, I think blockchain is about partially insourcing a piece of the technology or piece of the cost that has been outsourced. So, if I am using cloud, I am basically outsourcing storage, hosting, security services to the external host provider. Blockchain is really about basically insourcing a part of that and so you basically just run your own node in your own data center. That is the idea. You can do it in the cloud, but then you are basically more talking about blockchain as a service. I do not really see it as a blockchain, it is more, again, a centralized cloud. So, it is about basically taking back some of the functionality in-house again. So, it might come with a cost.

Magdalena Paula Brück

All right, we reached the end. Have we missed something, or do you think something else is important to mention or to add?

Christiaan Sluijs

No, I do not think so. I think we have been talking about all the relevant stuff maybe important to know is that of course is blockchain is not the privacy solution. So everything that is on blockchain is not private. That is something that we focus very often, very much on, and that is something that a lot of blockchain solutions really fail in terms of privacy. So we really need to make sure that if you are looking to blockchain solutions a lot of those solutions, they do not really provide a very decent solution in terms of privacy, because if you put data on the blockchain, it will be there forever for everyone. We have seen blockchain implementations where people are using a blockchain to validate that hash, but the data itself was stored in a centralized database. Of course, then you are against centralizing things. So, if you just use blockchain for notarization, but centralizing at the

back all the data in one central database, you do not really decentralize. But that is the whole idea. So how far do you need to go in terms of decentralization? It is a long debate, there are a lot of different opinions, but it is something that you need to consider if you talk about privacy. So, everything that has been centralized, of course, it is not private. We know that in the B2C world Facebook is a very nice example for a company that is not respecting our privacy. Of course, that is B2C, it is not B2B. But in B2B you have a lot of examples where centralized databases has been acquired by third parties, by competitors. And suddenly, you are using a certain application, and all of a sudden it has been acquired by a third party and your data, your confidential, your business is acquired by your competitor. And that is, of course, a huge risk. And so I think that the fact that some B2B businesses are still "under digitized" has to do with the fact that they do not trust the cloud, a centralized database, because it is very vulnerable in terms of who acquires that data.

Magdalena Paula Brück

Perfect. This was extremely informative. I thank you so much.

Christiaan Sluijs

You are welcome.

Magdalena Paula Brück

It will help me a lot for the master thesis. I am really ambitious in this topic, it is my interest. So, I am actually glad being able to write about it.

Christiaan Sluijs

OK, that sounds good. Well, maybe it is interesting to share your thesis once it is finalized.

Magdalena Paula Brück

All right, I can send it to you.

Christiaan Sluijs

OK, awesome.

Magdalena Paula Brück

Thank you very much for taking your time.

Christiaan Sluijs

Good luck, bye.

Magdalena Paula Brück

Goodbye.