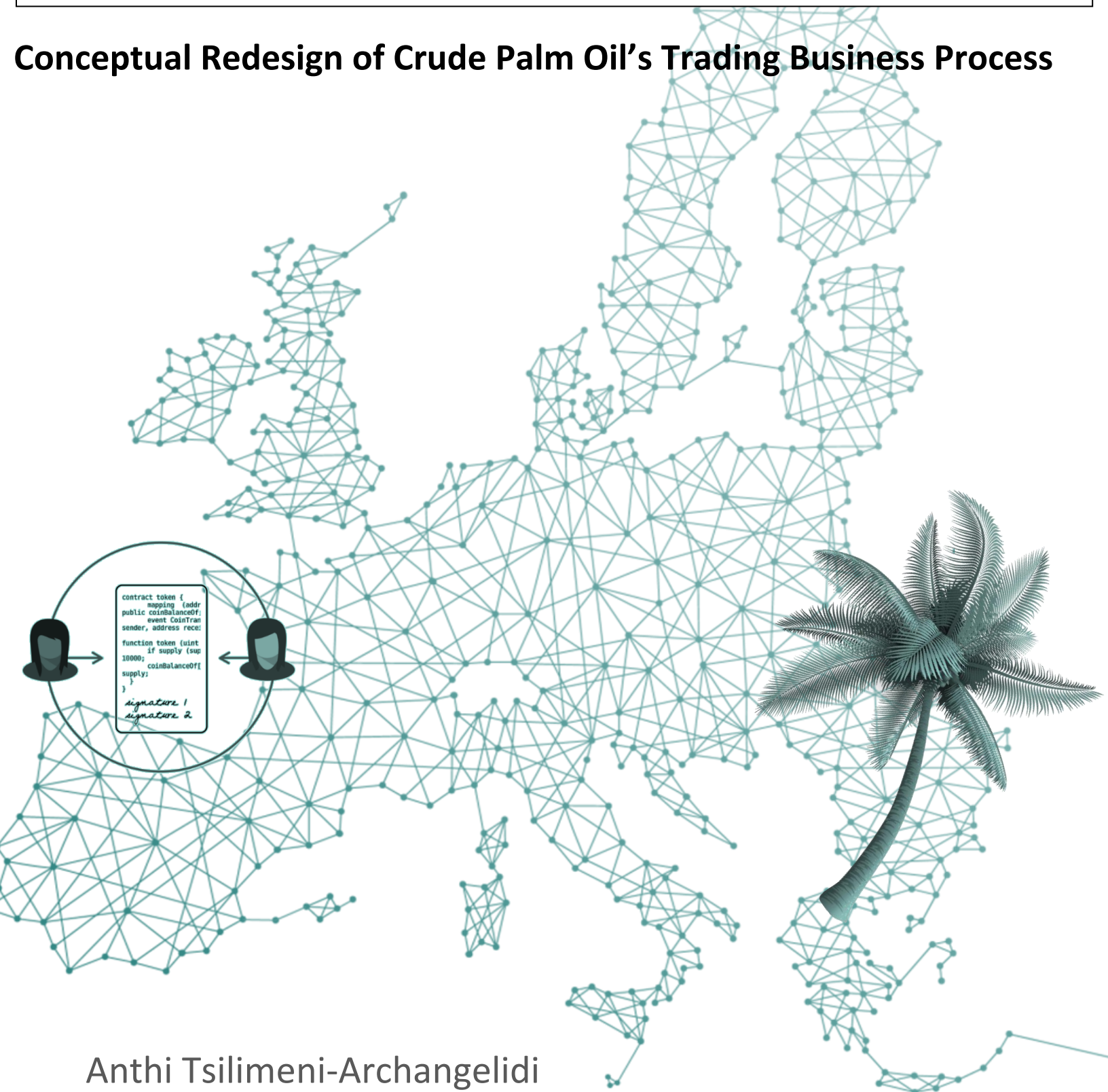


BLOCKCHAIN TECHNOLOGY IN SUPPLY CHAIN

Conceptual Redesign of Crude Palm Oil's Trading Business Process



Anthi Tsilimeni-Archangelidi

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Conceptual Redesign of Crude Palm Oil's Trading Business Process

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by

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Anthi Tsilimeni-Archangelidi
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Disclaimer: The views, thoughts and opinions expressed in this thesis report are those of the author's and do not necessarily reflect the views of Cargill B.V.

SUMMARY:

The international trade sector is expected to undergo a great transformation over the upcoming years where transparency and trust are the leading issues to be solved during the revolution of the emerging Industry 4.0 (PwC, 2016). International trade encompasses complex processes requiring several intermediaries that incur high transaction costs while many errors in manual paperwork occur and quality degradation of the product throughout its transportation around the globe may arise. The volume of data is skyrocketing as the industry is trying to provide accurate and real time information that can be distributed around several parties.

Meanwhile, the emergence of blockchain is promising to facilitate such business processes especially when combined with smart contracts (Mendeling et.al., 2017; Weber et. al., 2016; Staples, et al., 2017). Smart contracts can be seen as a computerized transaction protocol that executes the terms of a contract (Szabo, 1994). Even though smart contracts is a concept visualized already in the nineties, blockchain is the first technology that can officially support their implementation (Morabito, 2017).

Literature review showed that the integration of blockchain in business processes is still under-researched while research related to supply chain inter-organizational business processes is scarce. This thesis aims to fill that gap by **designing the business process of Crude Palm Oil (CPO) trading between a buyer and a seller in Cargill, so that it addresses the inefficiencies of the current process by integrating blockchain technology and incorporating market's business rules.**

In order to guide the design process, the Design Science Research (DSR) has been adopted since it is supporting the building and evaluation of such designs in a rigorous and comprehensive way (Peffer, Tuunanen, Rothenberger, & Chatterjee, 2007). Following the approach presented by Kuechler and Vaishavi (2008), five phases are distinguished: a) Problem Awareness, b) Suggestion, c) Development, d) Evaluation, e) Conclusion. This work is structured upon those phases.

During the problem awareness phase the chosen business process is mapped and further analysed. The result is mapped in a flowchart where five process steps are identified: 1) Trade Agreement, 2) Loading, 3) Contract Execution, 4) Unloading, 5) Finalization. In total, more than 80 actions, 23 actors and 65 interactions between them is found. The analysis of the process shows that actors spend a lot of time on non-value added activities due to the need for checking the counterparty's

input while at the same time data are entered multiple times to excel files, e-mails and ERP systems. The need for digitalization and automation of shared information among parties is further supported by the mapped organizations business model and strategy.

Next, in the suggestion phase the blockchain solutions that are considered relevant to the supply chain management field are identified. The author suggests that the several applications can be listed in accordance with the supply chain flows (information, physical and financial flow) where the technology can help by either monitoring or coordinating such flows. The actors of the process contribute in the identification of the critical-to-quality (CTQ) factors which include reduction of administration tasks, reduction of back and forth communication, easiness to re-use data and minimization of error points. The actor's requirements -translated in CTQ factors- are matched with blockchain's capabilities and a suggestion emerges. The proposal is regarding a blockchain supported platform which can enable the entering and sharing of information while automation of actions which can replicate business logic (eg. triggering financial transactions or forwarding data to other parties) can be further supported.

The development phase, emphasizes on administration tasks and the associated interactions between the process' buyer and seller where input from the previous phase is used. An agile approach is adopted throughout this phase. The new design is first created by the author based on the collected information, next it is discussed with a continuous improvement expert and with at least one actor representing the process step. A third iteration is then made and a feedback from the related actor's is given. The re-engineered business process is corrected and is the considered to be final.

Next, during evaluation it was estimated that the new business process can offer up to 85% time savings and that it can work only if such a solution is fully integrated with ERP systems. In addition, from the actor's perspective it was mentioned that degree of flexibility, speed of entering transactions and interoperability between systems were the most important factors of success. It was further underlined that all supply chain actors would need to be part of the inter-organizational business process so that full potential can be realized. Additionally, blockchain experts underlined that the real power of the solution is the automated business logic while issues regarding maintenance and governance are expected to arise in the future.

Recommendations for Cargill and a roadmap for adoption is crafted. It is recommended to take a holistic view when preparing for adoption and take incremental steps to ensure that the rest of the supply chain ecosystem can follow.

For future research, it is suggested to map the full ecosystem of the crude palm oil trading business process and evaluate the benefits when the whole network including competitors and supply chain partners participates. In addition, the applicability of the suggested redesign in other cases should be further investigated. Similar products in edible oils (eg. coconut oil) could be considered and check whether the findings can be generalized in the edible oils industry and next in the commodities overall.

The research contribution is threefold. First, from a practical point of view, the mapping and analysis facilitated the understanding of deficiencies in the current inter-organizational processes where the process was mapped in this report for the first time. Second, the proposed categorization of blockchain applications may help practitioners to realize the different uses of blockchain in the supply chain domain. Third, from a Business Process Management point of view, the re-engineered business process extends the knowledge in BPM and the domain of blockchain-based information systems where: i) a relevant process is identified, ii) the expected benefits are quantified, iii) a proof-of-concept leveraging opportunities offered by blockchain is created, iv) a holistic view of the business process is presented.

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CHAPTER 1: Introduction

The international trade sector is expected to undergo a great transformation over the upcoming years where transparency and trust are the leading issues to be solved during the revolution of the emerging Industry 4.0 (PwC, 2016). International trade encompasses a supply chain sector of €16 trillion (Boucher, Nascimento, & Kritikos, 2017) and it involves several processes of goods production, transformation and distribution through a network of stakeholders such as producers, retailers, distributors and transporters. Each of those actors are associated with a plethora of different processes, involving managing contracts, payments, traceability, labelling, sealing, anti-fraud and anti-counterfeit (Boucher, Nascimento, & Kritikos, 2017).

Due to the process' complexity, it requires several intermediaries for services such as transportation of goods, quality assurance, delivery of original documents or bank payments that incur high transaction costs. During international trade, many errors in manual paperwork occur and quality degradation of the product throughout its transportation around the globe may arise. The volume of data is skyrocketing as the industry is trying to provide accurate and real-time information that can be distributed around several parties. More specific, during the physical trading of a commodity (eg. crude palm oil), several interdependent actors such as freight forwarders, customs, buyer, seller and banks have to collaborate (UN/CEFACT, 2008) and each of them needs to be provided with a different set of information to successfully facilitate the trade.

Blockchain is believed to have a high potential in facilitating such business processes especially when combined with smart contracts (Mendeling et.al., 2017; Weber et. al., 2016; Staples, et al., 2017). Smart contracts can be seen as a computerized transaction protocol that executes the terms of a contract (Szabo, 1994). Even though smart contracts is a concept visualized already in the nineties, blockchain is the first technology that can officially support their implementation (Morabito, 2017). In literature, smart contracts and blockchain technology are inseparable terms that together are forming the second generation of blockchain technology (Swan, 2015).

Neither blockchain nor the implementation of smart contracts is mature yet (Bashir, 2017; Zhao, Fan, & Yan, 2016) and the advantages of the technology within supply chain business processes are expected to become valuable in the future once blockchain infrastructure and standards have both developed and matured (Beck, Avital, Rossi, & Thatcher, 2017). The thesis will give a closer insight and specify the opportunities that blockchain could offer to inter-organizational business processes, in the supply chain assuming that the technological aspects of it will be solved in the

future. ***The thesis will focus on the analysis of a specific business process and re-engineer it by introducing solutions that can be enabled by blockchain technology.***

In this first chapter, the problem statement will be presented where the context and scope of the research will be specified. Next the research objective together with the research questions will be defined. At the end of this chapter the outline of the thesis document will be described.

1.1 Problem Statement

During the international trade of commodities, some original documents (eg. contract, bill of lading, shipping information, certificate of origin) are often required and those can take weeks to travel around the globe while their online distribution is holding the risk of forge. Furthermore, data related to commodity trading are not shared efficiently -and sometimes not at all- since they are still siloed within companies or legacy IT systems (McKinsey, 2016). It is estimated that the traditional paper forms that are used by traders, for exchanging core information, are accountable for the 5-10% of the total world trade cost (United Nations, 2006).

Connecting such business processes in a cross-organizational way, gives the opportunity to reshape them beyond organizational boundaries (van der Aalst, 2000) and it is proven to have several benefits (Xu, Liu, Wang, & Wang, 2009). Examples of benefits that can be realized when a business process is connected cross organizationally include: greater process transparency and predictability, higher degree of integration, enhanced communication and time savings in terms of higher throughput in a given time interval, faster document processing and release of goods, faster payments and reduced transaction costs (United Nations, 2006; Schulz & Orlowska, 2004).

Traditionally, the coordination among the several actors in the supply chain is realized via message exchanges (Dumas, La Rosa, Mendling, & Reijers, 2018) since organizations cannot agree on a central provider to manage their processes collectively (Fridgen, Urbach, Radszuwill, & Ultz, 2018). The coordination of this kind of inter-organizational processes among parties is considered to be enabled via blockchain technology where the record of tamper proof digital events (Beck, Avital, Rossi, & Thatcher, 2017) as well as the execution of transactions (Dumas, La Rosa, Mendling, & Reijers, 2018) are made possible.

When it comes to supply chain, tracking physical assets and related data can be stored through blockchain resulting in the improvement the logistics visibility and provide benefits in ensuring the integrity of data (World Economic Forum, 2017). Ownership changes can be tracked in

blockchain where key events can trigger automatic payments through smart contracts (Staples, et al., 2017) . As it will be explained in chapter 2, the term ‘smart contracts’ refers to “self-executing scripts that reside on the blockchain” (Christidis & Devetsikiotis, 2016).

Even though, the legal status of smart contracts is still debated, it can provide evidence and facilitate the execution of a legal contract (Staples, et al., 2017). Smart contracts can ensure that the joint process is correctly executed and appears as a technology that could reduce the risk of fraud or error, could speed up real-time updates and reduce third party intermediaries that provide “trust” services (Deloitte, 2016).

The practical problem to be solved in this thesis is designing a business process that can address the current inefficiencies. From a scientific perspective, the findings and lessons learned throughout the empirical process can be abstracted into a body of knowledge and contribute to the Business Process Management domain where the results can help in understanding how inter-organizational business processes can be coordinated with the help of blockchain technology.

1.2 Thesis Objective

After presenting the problem which is about to be tackled, throughout the research, the thesis objective can now be formulated. The main goal of this research is to *explore the opportunities that blockchain could bring to inter-organizational business processes related with international supply chains and evaluate the benefits and challenges of such an application* .

Given the time and resource limitations of this research, the palm oil supply chain was chosen where the international trading of crude palm oil (CPO) will be put under scrutiny. The main focus will be shed between the buyer and the seller of such a process and for the needs of this research primary data will be collected from Cargill Inc. The reason behind selecting this case is that it seems to be a well-fit candidate for blockchain implementation as it is a regulated process where more than 80% of the market is trading with the same business rules, actors have conflicting interests in several parts of the case, while a lot of interdependent transactions exist which are now executed through complex and manual workflows.

In order to define and evaluate the opportunities that blockchain could bring to the aforementioned process, a new process should be designed. Thus, the research objective of this thesis is to: **Design a business process of CPO trading between a buyer and a seller in**

Cargill, so that it addresses the inefficiencies of the current process by integrating blockchain technology and incorporating market's business rules.

1.3 Research Questions

The following research questions were formulated as an input for the objective that was presented in the previous section.

Main Research Question:

What kind of benefits can the application of blockchain technology bring to the inter-organizational business process of physical palm oil trading in Cargill?

- **Research Question 1:** What are the bottlenecks and improvement opportunities in the current business process of physical trading of crude palm oil in Cargill?

The implied sub-objective to be achieved is the analysis of the current business process and the identification of inefficiencies.

- **Research Question 2:** What kind of blockchain applications are suitable for the Physical Trading of Crude Palm Oil?

The implied sub-objective entails the identification of innovations that span the blockchain and supply chain and/or business process field.

- **Research Question 3:** How can the Business Process be re-designed once the blockchain component is introduced?

The implied sub-objective is regarding the redesign that incorporates blockchain technology as an attempt to address inefficiencies of the current state. This will be an iterative procedure so that a robust design can emerge.

A schematic representation depicting the logical sequence of the Research Questions can be seen in figure 1, in the next page. The research questions will be further scrutinized in the methodology section (chapter 3), where sub-questions will be formulated and the associated methods for tackling them will be presented.

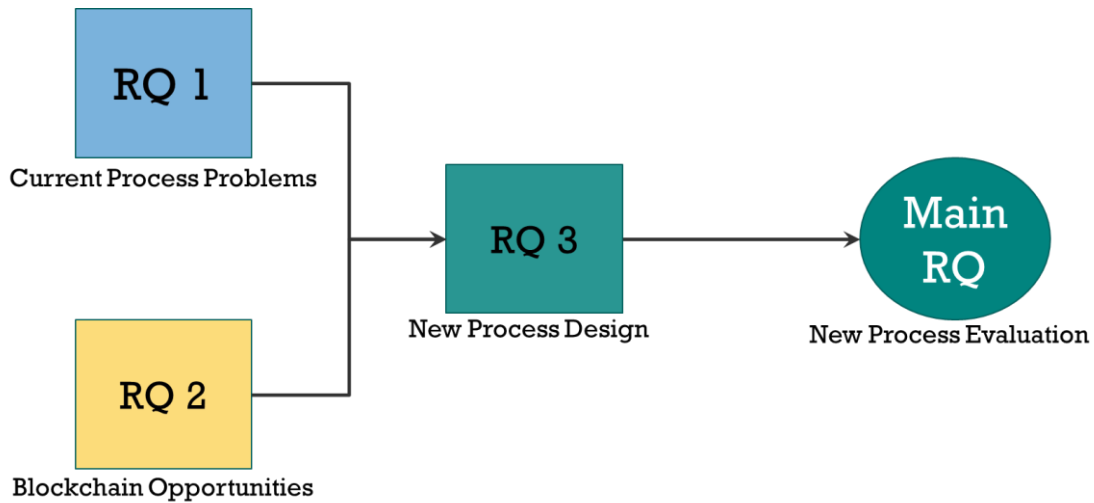


Figure 1: Logical Sequence of the Research Questions

1.4 Thesis Outline

In this section, the contents of each chapter will be summarized. In the current chapter (Chapter 1) the topic and the general problem was identified while the research objective and the associated research questions are presented.

In Chapter 2, the literature review that helped to identify the research gap whereupon the research objective of the thesis was designed, is presented. In this chapter, a literature review for both the selected use case which the physical trading of crude palm oil as well as the blockchain technology is scrutinized. Based on the identified research gap, the main questions and sub-questions are then built and presented.

In Chapter 3, the research methods that were chosen in order to respond to the research questions can be found. The main method that is governing this report -namely the Design Science Research approach- is presented and its adoption is motivated. Next, the research framework is composed where the steps that were followed to reach the research objective together with the methodology and associated tools that were used throughout the report are schematically represented. Subsequently, the research methods and tools used for each step are described and the reasoning behind each choice is justified. Data collection methods such as literature review, interviews and workshops together with business process and strategic management tools that will be used in next chapters are described.

In Chapter 4, the internal environment of the chosen business process is mapped and scrutinized while the business model and strategy of the organization is analysed. Next, the chosen business process is also mapped, where a flowchart is designed with the help of actors that are involved in the process. Its performance is then analysed both qualitatively and quantitatively and conclusions are drawn with respect to the spotted bottlenecks of the process.

In Chapter 5, the blockchain applications that could contribute to an improvement of the current process are found from an extended literature review and the author is proposing to categorize the applications based on the three supply chain flows (information, physical and financial flow) while also considering their business process functionality. The blockchain solutions are then matched with the identified problems of the process and a suggestion for re-design emerges.

In Chapter 6, a new business process emerges. This is accomplished by using the blockchain solutions that were identified in chapter 5 as an attempt to address the business process' bottlenecks that were detected in chapter 4. The contents of the new design are evaluated by the involved actors whereupon parts of the process are revisited. The final outcome is a result of three iterations.

In Chapter 7 the new design is evaluated and it is checked whether the re-engineered process is in line with the organization's business model and future strategy. Furthermore, the model is evaluated by the process' actors while the suitability of the industry is also assessed. The expected benefits are presented and based on the findings, a roadmap for adoption of such a design is proposed.

The thesis concludes with Chapter 8 where the final conclusion is drawn. First, the answers to the research questions are explicitly given. Second, the practical and scientific contribution in the current knowledge base is illustrated. Third, the limitations faced during the research and reflection based on whether and how the research objective was met are drawn. The thesis ends by proposing several topics for future research.

CHAPTER 2: Literature Review

This chapter comprises of a literature review of all important topics that are about to be scrutinized throughout the report. The funnel approach is used in order to structure the literature review where concepts are initially presented from a general perspective and then the focus is narrowed throughout the chapter (Hair, Wolfinbarger, Money, Samouel, & Page, 2015; Teddlie & Tashakkori, 2009).

Next the research gaps are identified. Those are the gaps which contributed in defining the research objective and associated research questions that were presented in the previous chapter.

The literature review was split in 2 streams;

- one regarding the **international trade** whereupon the review is funnelling towards a specific business process
- one regarding the **blockchain technology** where this new innovation is explained and previous work which is combining blockchain with international trade or business processes is scrutinized.

Both literature review streams were conducted in order to:

- i) *define the basic concepts of the thesis,*
- ii) *realize the state of the current developments*
- iii) *identify the challenges that need to be tackled in future research.* As stated at the start of this section, the aim of this step was to identify the gaps that underlie the existing literature so that the research questions can be constructed based on a gap-spotting approach.

Based on the literature gaps that will be identified in this chapter together with the construction of the research questions, a suitable methodology that contribute in meeting the research objective and a formulation of sub-questions will be chosen in chapter 3 whereupon a research framework will be designed.

In order to define the basic concepts of this thesis, a preliminary search using several databases such as IEEE Xplore, Science Direct Search and Google Scholar was performed. Examples of keywords used include “commodity trading”, “interorganizational business processes”, “international supply chain business process”, “international trade law”, “commodity trading contracts”, “challenges and opportunities in the international supply chain”, “blockchain”,

“distributed ledgers”, “smart contracts”, “blockchain taxonomies”, “blockchain and business processes management”, “blockchain applications”, “blockchain prototypes” and “blockchain in supply chain”.

The collection and analysis of relevant literature initiated the research and helped the researcher in gaining an overall insight of the problem. Due to the novelty of the blockchain field, few conference proceedings were scanned in order to get an insight of the technology’s state of the art, understand concepts and problems that are currently attempted to be tackled. Additionally, handbooks were used to review recent developments and journals were carefully read that could be used for theory building.

In order to have a systematic literature review, the **snowballing method** was used in both literature streams. Snowballing is defined as a method that uses “the reference list of a paper or the citations to the paper to identify additional papers (Jalali & Wohlin, 2014) . In recent core papers that were found through keyword search, the backward snowballing was mostly used where the references of the paper were further searched. This led to identify older but fundamental papers that were used as a basis (eg. smart contracts concept which was developed in the 90s) and could provide a holistic view of the subject.

Backward snowballing was also used in fresh and less sophisticated sources when credibility was doubted (eg. conference proceedings or references from presentations, magazines or blogs) that were not considered as reliable on their own. Forward snowballing (i.e. searching for citations of a useful paper) was applied in order to evaluate proposed theories, verify their acceptance from the scientific community and search for feedback and criticisms of papers.

It is worth mentioning that the researcher was bound to search certain keywords on a regular basis due to the novelty of the topic and the fact that new publications were constantly available.

2.1 Typical Issues in the International Trading

Today's international trade consists of a global network that includes several separate entities responsible of different tasks such as harvesting, transportation, distribution and payment of products worldwide. It is considered that one of the major challenges in international trade is creating a network that can allow collaboration across organizational boundaries in an adaptive, flexible and dynamic environment that can be both reliable and secure (Perona & Miragliotta, 2004).

It is further mentioned that a lack of coordination occurs due to information asymmetry and in this case, the performance of supply chain is compromised (Sahin & Robinson, 2002). Furthermore, it is found that trade costs in international trade are enormous and include transport costs, border related trade barriers and costs related to distribution (Anderson & van Wincoop, 2004) while the actual cost of international trade have not been quantified yet (Klievink, et al., 2012).

2.1.1 International Trade of Commodities

A commodity can be defined as a basic good that has full – or partial but substantial – fungibility. In simpler terms, a commodity is a good that is interchangeable with other commodities of the same type (Chatnani, 2009). While the quality of a given commodity may differ slightly, it is essentially uniform across producers – a bushel of corn or a barrel of oil is essentially the same commodity, regardless of the producer.

Commodities may undergo several changes from their raw state into a form that can actually be consumed and usually encompass risk due to the uncertainties of the future market values. Commodity trading firms may provide both risk management expertise services and also commodity transformation services (Chevallier & Ielpo, 2013). Transformation of commodities involve:

- space transformation which regards the transportation of a commodity from one location to another)
- time transformation which is related to storage of the commodity and its delivery at a later time
- form transformation where a commodity is processed (eg. cocoa bean to cocoa powder) (Pirrong, 2014) (Baker, Filbeck, & Harris, 2018).

When traded on exchanges, commodities must meet specified standards defined by exchange rules. The trading of commodities is usually carried out through futures contracts that standardize the quantity and minimum quality of the commodity being traded. When traded, the cost of transportation, storage and spoilage needs to be considered. For this reason, most commodities are traded on exchanges for future delivery

Standardization of the amount and quality of the commodity is an important feature of exchange-traded commodity futures contracts. Specifications differ for each commodity, but the uses unified contract is the same for all trades. The vast majority of Edible Fats & Oils is traded under contracts created by FOSFA (Federation of Oils, Seeds and fats Association) which is a professional international contract-issuing and arbitral body concerned exclusively with the international trade in oilseeds, oils, fats and edible groundnuts (FOSFA, 2014). The association strives to regulate the procedure and promote practical solutions. This makes the physical trading a standardized and regulated procedure.

FOSFA provides several different contracts per commodity. The association stipulates rules regarding the quality, quantity, delivery time and payment terms of the product as well as the shipping documents that need to accompany the commodity. Internationally, 85% of the global trade in oils and fats is traded under FOSFA contracts (FOSFA, 2014).

2.1.2 Supply Chain of the Palm Oil Commodity

It will be explained on a later chapter that the physical trading of crude palm oil will be taken as a case study. The blockchain opportunities for that business process will be investigated during the thesis. Such a trading is usually governed by a FOSFA contract.

The supply chain of palm oil can be seen in Figure 2 in the next page. The related activities from plantation to the consumer includes harvesting of the fresh fruit bunches (the fruit of palm tree), crushing & clarification, refining & modification, product manufacturing and distribution & retail (WWF, 2002).

It is a complicated process that includes time, space and form transformations throughout its full supply chain and it includes an array of players, from growers to consumer goods manufacturers.

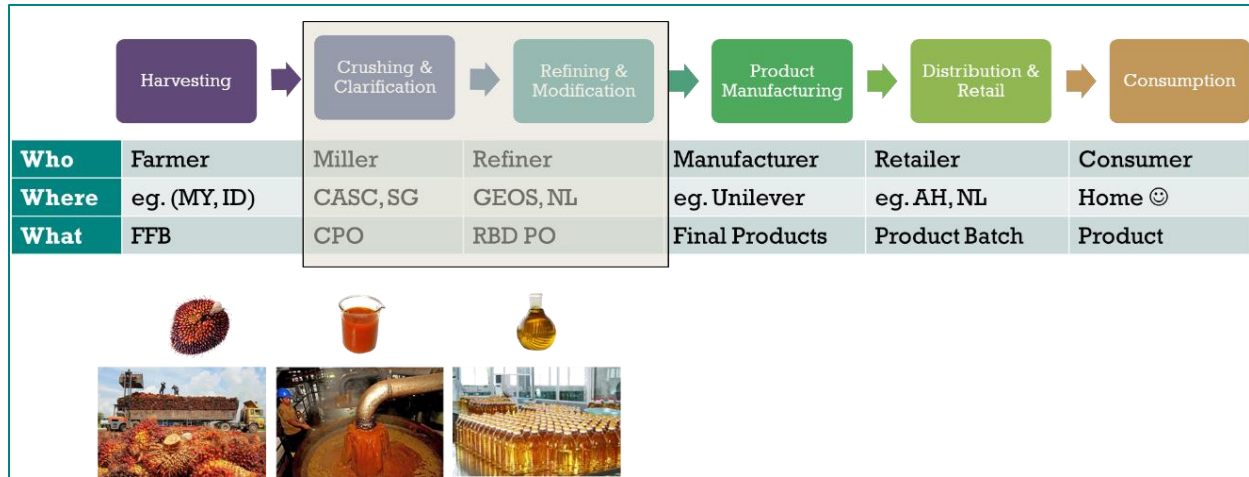


Figure 2: The Palm Oil Supply Chain, FFB: fresh fruit bunches, CPO: Crude Palm Oil, RBD: Refined Bleached and Deodorized Palm Oil

The process of interest is the global physical trading of crude palm oil. It comprises of a space transformation and the commodity's change of ownership. The lower boundary of this process is right after milling at a collection port in one country and the upper boundary is right before refining -still in crude palm oil form- when the product has arrived and is unloaded in shore tanks at another port.

2.2 Blockchain Technology Literature Review

An Aristotelian¹ definition of blockchain is the one of a **shared, immutable, distributed ledger that can facilitate the process of recording transactions and tracking assets in a business network** (Gupta, IBM, 2017).

Ledgers have been used since the very start of the modern capitalism and was adopted from accounting as a tool to keep track of assets, transactions and ownership information. The credibility, immutability and distribution of information inserted in ledgers was ensured until now by a centralized entity (MacDonald, Allen, & Potts, 2016). In the case of blockchain, such a ledger has a build-in trust mechanism that can take care of the distribution of reliable information (The Economist, 2015).

As depicted in Figure 3, blockchain belongs in the intersection of 3 known fields: a) Game Theory, b) Software Engineering and c) Cryptography Science (Mougayar, 2016).

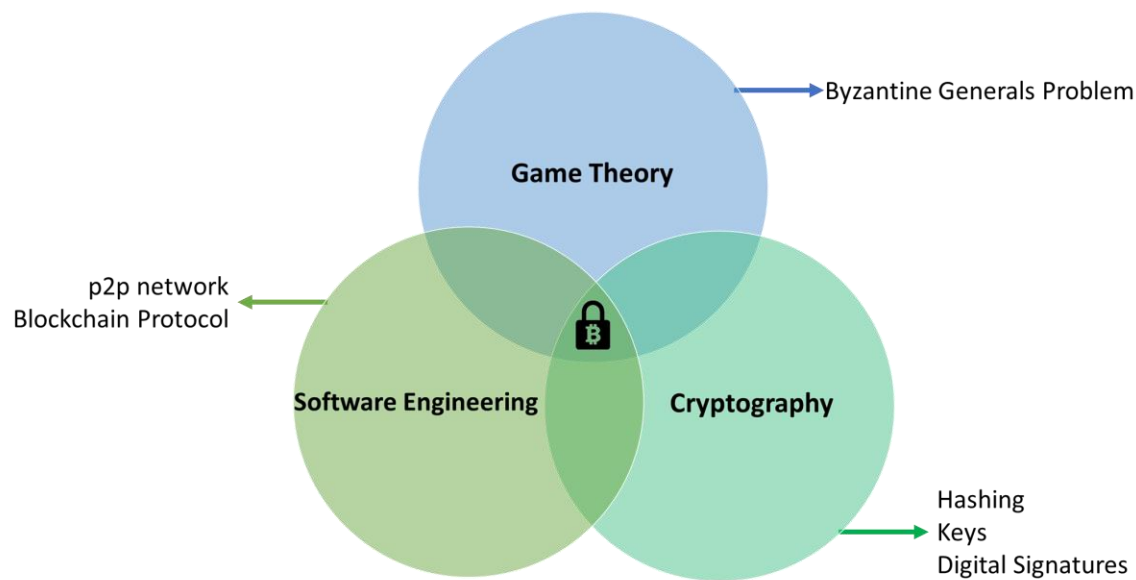


Figure 3: Blockchain as an intersection of cryptography, p2p and blockchain protocol

From a game theory point of view, it solved the so called “Byzantine Generals Problem”. Blockchain is furthermore integrating technologies from software engineering (peer to peer networks, blockchain protocol) and cryptography (hashing, digital keys, digital signatures)

¹ Aristotle had it that an object's essential attributes form its "essential nature", and that a definition of the object must include these essential attributes.

(Mougayar, 2016). The peer to peer network technology ensures that information can be distributed within a network, the underlying cryptography can ensure security of the information while the blockchain protocol guarantees that the ledger is immutable and ordered.

This means that a ledger can be updated by adding records at the end of the ledger at any given time and not overwrite records on top of old ones (Pass, Seeman, & Shelat, 2017). All records are organized in data batches called blocks that use cryptographic validation to link themselves together. A conceptual representation of such data batches (blocks), is depicted in Figure 4 below.

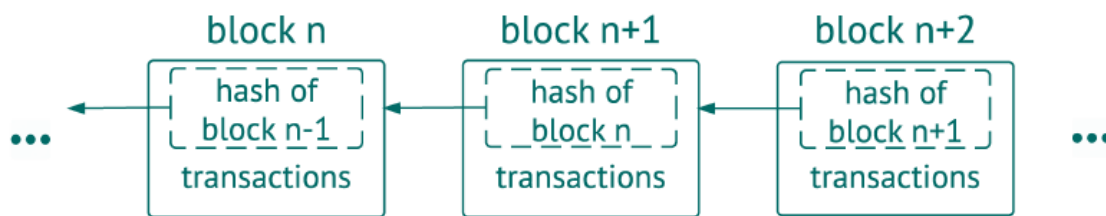


Figure 4: Representation of blockchain, as presented by Christidis and Devetsikiotis (2016)

Each block typically contains a hash pointer as a link to a previous block, a timestamp and transaction data. In that way, data are permanently recorded in a linear sequence over time, called blocks (Christidis & Devetsikiotis, 2016; Mougayar, 2016; Nakamoto, 2008). The term “blockchain” emerged from that process (Nakamoto, 2008).

2.2.1 Blockchain Generations

Blockchain was categorized by Swan (2015) in three generations and has been referred as:

- Blockchain 1.0 (Currency)
- Blockchain 2.0 (Smart Contracts)
- Blockchain 3.0 (Decentralized Applications).

The first generation is referring to currencies and it started with the invention of bitcoin and followed by the rise of cryptocurrencies where it includes applications related to payments such as digital payment systems. The second generation extends the notion of decentralization of money and payments and expands to the exchange of any assets followed by the decentralization of markets in general. Blockchain 2.0 includes any part of the economic market and extends its applications to stocks, mortgages, transfers of ownership and smart contracts (Bashir, 2017).

Next, the third generation refers to Decentralized applications (Daaps) expanded in other areas which are considered more general purpose industries such as government, health and science (Raval, 2016). The first two generations will be reviewed in the next two section while the third generation is considered to be out of scope of this research. The three generations are conceptualized in Figure 5.

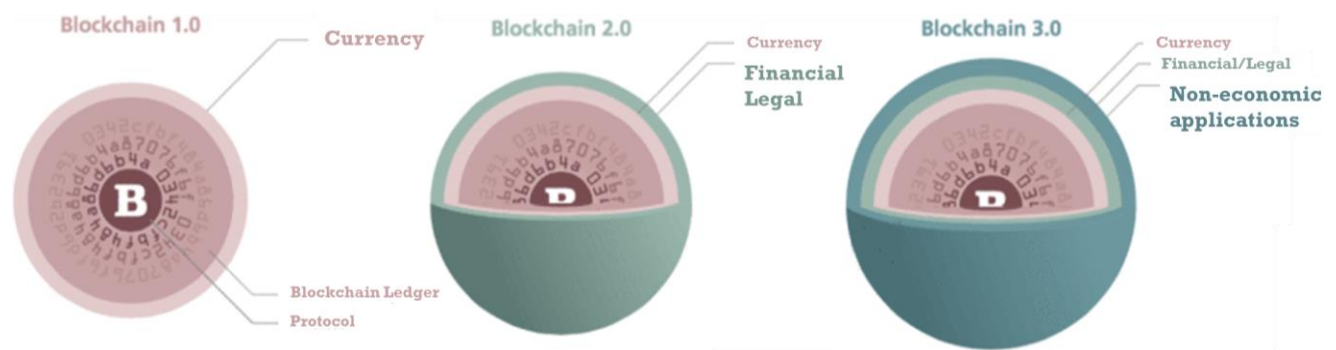


Figure 5: Blockchain generations, adapted from <https://blog.knoldus.com/2017/08/16/getting-an-insight-of-blockchain/>

Blockchain 1.0 – (Crypto)currencies

Blockchain technology was firstly introduced in an online paper in 2008 by the alias Satoshi Nakamoto whose identity is up to date, unknown. As mentioned in the previous section, blockchain integrates three technologies. The novelty of Nakamoto's work was not those associated technologies themselves but their intersection that eventually solved the double-spending problem.

The author(s) of that paper introduced Bitcoin as a revolutionary peer-to-peer version of electronic cash system that could be used without the participation of financial institutions (Nakamoto, 2008). The exclusion of such institutions would be accomplished by shifting the trust mechanism of such transactions from a central trust mechanism (such as banks) to a cryptographic proof emerging from computer power. In this way, the trust is put in the network rather than in a central institution (Mougayar, 2016).

In all, the work of Nakamoto showed that blockchain covers a wide spectrum of capabilities (Mougayar, 2016):

- **Technical:** a back-end database
- **Business:** a network moving value between peers
- **Legal:** a build-in trust where a validation mechanism does not require intermediaries

The technology is in many occasions understood as an institutional or social technology for coordinating people (Davidson, De Fillippi, & Potts, 2016).

Blockchain 2.0 – Smart Contracts

Compared with the first generation of blockchain, smart contracts enable the encoding of several conditions (not only related to an electronic cash system or assets transfer), can introduce loops and have internal state, where a much richer array of transactions becomes possible (Peters & Panayi, 2015).

The concept of **smart contracts** was **firstly presented by Nick Szabo in 1994** (Szabo, 1994). At that time, the **concept was developed only theoretically since there was no platform that could support its actual implementation**. Szabo described smart contracts as: “a computerized transaction protocol that executes the terms of a contract. The general objectives are to satisfy common contractual conditions (such as payment terms, liens, confidentiality and even enforcement), minimize exceptions both malicious and accidental, and minimize the need for trusted intermediaries. Related economic goals include lowering fraud loss, arbitrations and enforcement costs, and other transaction costs (Szabo, 1994)”.

Szabo’s idea was unrealized up to now since there was no technology that could support programmable agreements and transactions between parties (Morabito, 2017). The concept was only brought to life during the next tier of blockchain development -referred to literature as Blockchain 2.0 (Swan, 2015)- as an attempt to investigate further applications that bitcoin’s underlying technology can offer, except the one of being a cash system.

There were two challenges that had to be tackled so that smart contracts can be implemented. First, in order to have enforceable agreements a way to control physical assets had to be realized and second trusted and reliable computers had to be found for executing the smart contracts code (Morabito, 2017). The idea of the automatic execution of contracts seems plausible if blockchain and smart contracts are integrated so that payments or other actions are triggered once a pre-programmed condition of a contractual agreement is satisfied (Crosby, Nachiapan, Pattanayak, Verma, & Kalyanaraman, 2016). In Figure 6 (next page), the utilization of smart contracts is explained in 3 steps.

Regarding the realization of smart contracts, Szabo himself stated that “blockchain technology appears very much to be the jet fuel necessary for smart contracts to become commonplace in business transactions and beyond (Chamber of Digital Commerce, 2016)”.

In 2012, Vitalik Buterin who was exploring the several blockchain applications, realized that all projects were “about specific applications and not being sufficiently general (Buterin, 2012)”. He soon came up with the idea of Ethereum; an open-source blockchain based platform that featured a smart contract functionality.

Buterin published a whitepaper presenting the Ethereum platform and described it as a flexible blockchain based platform that can run digital cash, reputation systems, content rights management and track supply chains among other things (Buterin, 2013). The platform funds were publicly raised and Ethereum is now functioning as a “decentralized platform for applications that run exactly as programmed without any chance of fraud, censorship or third-party interference”. The platform focuses on running a programming code of any decentralized application beyond payments and electronic cash systems.

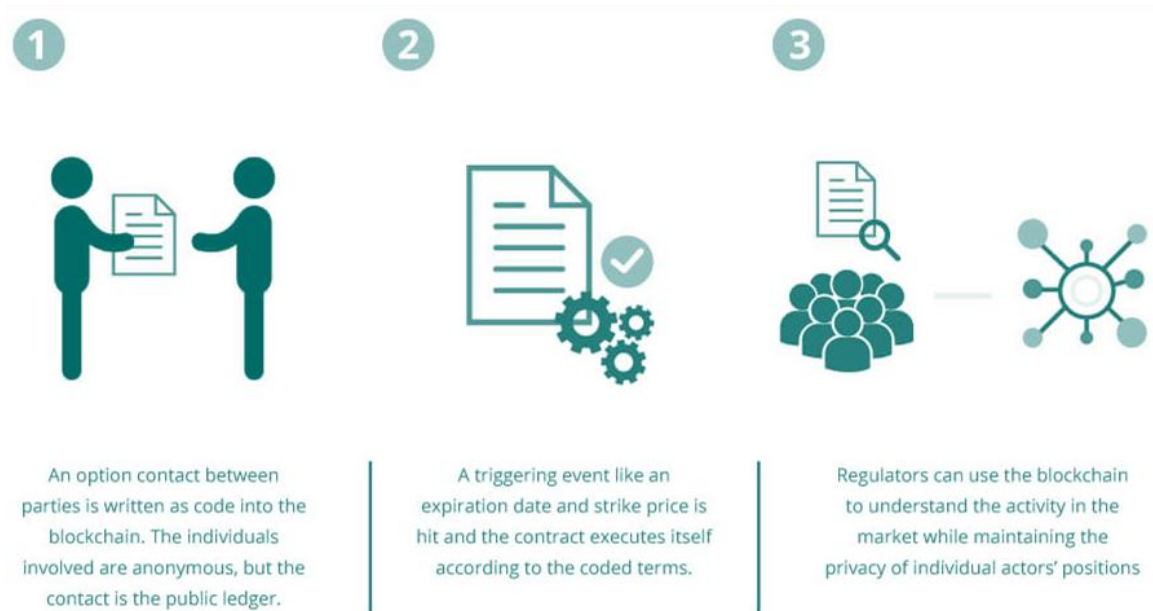


Figure 6: Generic example of a Smart Contract, retrieved from <https://blockgeeks.com/guides/smart-contracts/>

Several blockchain platforms have been created ever since with the most known ones being the pre-mentioned Ethereum and the Hyperledger Fabric which is developed in an open-source way and is hosted by The Linux Foundation (Hyperledger.org, 2017). Some of the other promising ones include R3 Corda, BigChain DB, Multichain, IOTA, Hyperledger Sawtooth, Hyperledger Iroha, Hyperledger Burrow and Hyperledger Indy (Linnhoff-Popien, Schneider, & Zaddach, 2017; Hyperledger.org, 2018).

Practical issues that still need to be resolved so that smart contracts is a working solution, includes scalability, code correctness and their legal enforceability which means that the programmable code can match with a legal counterpart (Peters & Panayi, 2015).

In all, smart contracts are seen as an ideal technology to interact with real-world assets, smart property, Internet of Things (IoT) and financial services instruments (Mougayar, 2016). It enables the financial, physical and information flows to coexist in one ecosystem. In order to convert a real world contract to a smart contract, it must be possible to represent it as a logical flow “if X, then Y, else Z” types of dependencies. Smart contracts is thought as the second generation of blockchain and have been considered to be an inseparable functionality of the technology.

In this report, **the term ‘smart contracts’ will always refer to “self-executing scripts that reside on the blockchain”** (Christidis & Devetsikiotis, 2016).

2.2.2 The Internet and Blockchain Analogy

Blockchain has been thought as the 5th pillar in IT revolution together with mainframes, PCs, the Internet and the Social Media. Blockchain is not considered to be a disruptive technology that will threaten an existing model with a lower cost solution but its rather thought of being a fundamental technology that can create new foundations for economic and social purposes (Iansiti & Lakhani, 2017). It can be thought as a layer of technology that is built on top of the internet, just as the world wide web (Mougayar, 2016) (National Research Council, 2006).



Figure 7: The 5 pillars of IT Revolution

The adoption trajectory of blockchain is predicted to be analogous to the one of the Internet Protocol Suite, commonly known as TCP/IP. TCP/IP was firstly introduced in 1972 for military purposes and is now considered to be the “technology” behind the internet and online networks (Iansiti & Lakhani, 2017) (Mougayar, 2016). Even though its first application was limited to the communication between the U.S. Defense officials, it expanded as the standard method for interconnecting hosts, internet and networks around the globe (Parziale, et al., 2006). In the same

analogy, blockchain started as the foundation technology behind cryptocurrencies -initially bitcoin- and is now expected to have many applications not only in financial services but also in other fields such as commodity trading, data management or digital identity.

TCP/IP enabled the creation of an open shared public network without any central authority or party responsible for its maintenance and improvement. Blockchain on the other side is not only enabling such a decentralized distribution of information but also empowering the storage, movement and transaction of value. So if TCP/IP brought the “internet of information” it can be said that blockchain will power the “internet of value” (Tapscott & Tapscott, 2016). Ginni Rometty, CEO of IBM had recently argued that “What the internet did for communications, blockchain will do for trusted transactions”.

Blockchain technology enables physical flow, information flow and financial flow to be integrated in one ecosystem. Therefore, if TCP/IP’s first application -e-mail- enabled bilateral messaging that decreased cost of connections, blockchain’s first application -bitcoin- enabled bilateral financial transactions that will decrease cost of transactions.



1st Application	e-mail	bitcoin
Pillar in IT revolution	3 rd	5 th
Decentralized Exchange of	information	value

Figure 8: Analogy between internet and blockchain technology

The evolution of internet of information to the one of value was envisioned back in 1981 from the head of MIT Laboratory for Computer Science, Michael Dertouzos. He describes the concept of “Information Marketplace” as “a 21st century village market place where people and computers buy, sell and freely exchange information and information services” (Dertouzos, 1997).

2.2.3 Comparing Blockchain with modern databases

The integration of blockchain technology in cross-organizations business processes is of rising importance (Dumas, La Rosa, Mendling, & Reijers, 2018; Mendeling et.al., 2017; Rimba, et al., 2017). The use of blockchain instead of traditional databases (eg. cloud services) is an architectural development which should be carefully selected.

It is found that its adoption brings extra costs in terms of execution and storage where scalability is still an issue to be addressed (Bass, Clements, & Kazaman, 2012; Xu, Liu, Wang, & Wang, 2009). Additionally, data-related matters such as security, confidentiality and integrity need to be considered (Peters & Panayi, 2015).

Modern databases can be either centralized or distributed and in the case of distributed ones they are more reliable, have a better performance and are more scalable (Elmasri & Navathe, 2010). When comparing conventional distributed databases with blockchain based databases, the latter one provides a mechanism than can detect and prevent potential conflicts and enhances reaching consensus across the network (Peters & Panayi, 2015). Since the invention of blockchain solved the so called “double spending problem” (Nakamoto, 2008), when two copies of the same data set are modified, the database will allow only one of the two conflicting entries while the other entry will be discarded.

Another difference is in the ability of blockchain databases to create smart contracts (described earlier in this section) where pieces of computer code can be executed within the network (Peters & Panayi, 2015).

2.2.4 Research in Blockchain and applications in Supply Chain or Commodities Trading

Harvard Business Review mentioned that global supply chains relationships are complex and the diversity of interests pose the kinds of challenges this technology seeks to address where the flow of goods and services between global business can be tracked (Casey & Wong, 2017). Current literature underlines the potential of blockchain in providing immutable supply chain records, building traceability systems and mechanisms for determining the provenance of goods (Tian, 2016; Korpela, Hallikas, & Dahlberg, 2017; Kim & Laskowski, 2016; Matila, 2016)

Tian (2016) elaborated on how the issue of information credibility in agri-food supply chain traceability systems could be solved once RFID and blockchain technologies are combined. Kim and Laskowski (2016) focused on supply chain provenance once an ontology driven blockchain

design is introduced while Korpela et. al (2017) explored the opportunities of blockchain in digital supply chains.

Most use cases are focusing on a specific application in supply chain such as trade documentation, trade finance and supply chain transparency. It is mentioned that global supply chains are complex systems where support streams for invoicing, documentation and regulatory requirements are necessary. For commodity trading processes, it is suggested that tracking of physical commodities along the supply chain and their finalization through smart contracts are the key challenges that can reduce costs significantly. (PwC, 2017)

There is however, a lack of literature that integrates several kinds of blockchain solutions within a supply chain process and presents them as a new business process or as an end-to-end solution. It is considered that there is limited research regarding where and how blockchain can be effectively applicable (Glazer, 2017) and there are scarce number of topics which have an application oriented contribution to blockchain (Risius & Spohrer, 2017). In addition, during the composition of this thesis a concise classification scheme of applications which are suitable for supply chain as a whole could not be found on the relevant literature.

2.2.5 Research in Blockchain and Business Processes

Until now, the coordination of processes that span across organizational boundaries has been realized via message exchanges (Dumas, La Rosa, Mendling, & Reijers, 2018) since organizations cannot agree on a central provider to manage their processes collectively (Fridgen, Urbach, Radszuwill, & Ultz, 2018).

The coordination of this kind of inter-organizational processes among parties is considered to be enabled via blockchain technology where the record of tamper proof digital events (Beck, Avital, Rossi, & Thatcher, 2017) as well as the execution of transactions (Dumas, La Rosa, Mendling, & Reijers, 2018) is made possible. It is shown that blockchain can be integrated into a choreography process in such a way that trust is maintained without requiring a central authority (Weber et. al., 2016).

The value of Business Process Management (BPM) has been classified in seven categories under the Value-driven BPM framework, namely: transparency, efficiency and quality, agility and compliance, integration and networking (Peter & Kirchmer, 2012). It is argued that the application of blockchain in business processes can offer improvements in all seven values of the above mentioned framework (Milani, Garcia-Bañuelos, & Dumas, 2016).

Weber et. al. (2016) illustrated a method for integrating blockchain into business processes that enabled monitoring and execution of that process, without the need of an auditing party. The researchers used blockchain in order to facilitate the business process in two ways:

- as a “**choreography monitor**”: this setting monitors the business process. It encompasses the data storage of immutable data so that a process execution status can be shared while an audit trail can be created. Therefore, the technology serves as a place to store joint and individual data.
- as an “**active mediator**”: this setting coordinates the execution of the business process. It can use smart contracts in order to implement the process and it can furthermore send or receive messages according to business model, transform data or execute calculations.

The method was evaluated by the creation of 500 contracts and the execution of over 8000 blockchain transactions (Weber et. al., 2016). This paper inspired a group of scientists to investigate the challenges and opportunities in Business Process Management where several research directions were proposed for future investigation (Mendeling et.al., 2017). Some of Mendeling’s (2017) suggestions for future research which are related with the report’s research included:

- a) the exploration of new methods for analysing and engineering business processes based on blockchain.
- b) developing techniques for identifying, discovering and analysing relevant processes.
- c) re-designing processes to leverage opportunities offered by blockchain.

The scientific community seems to widely acknowledge the innovative component of blockchain but the use cases are still under exploration. The work of Fridgen et. al (2018) is an example of such a use case where the researchers showed in a prototype design that the process of a documentary letter of credit was drastically improved when blockchain capabilities are integrated in its cross-organizational workflow management system.

Still, the experiences with developing blockchain solutions remain scarce and the technology is seeking for use cases (Glazer, 2017) where a taxonomy of BPM related use cases does not exist (Fridgen, Urbach, Radszuwill, & Ultz, 2018). Regarding research in this section’s field, it is considered that there is abundance of studies that analyse the technology in combination with human actors and their interaction with other individuals or organizations even though there are

well established methods and tools to do so (Risius & Spohrer, 2017). It is furthermore mentioned that distinct benefit of blockchain based business process applications has not been thoroughly investigated (Fridgen, Urbach, Radszuwill, & Ultz, 2018) and the benefits of immutability or decentralized control has not been translated into monetary value yet (Risius & Spohrer, 2017).

2.3 Literature Gap

Throughout the above literature review, the identified literature gaps have been underlined. In general, a lot of research papers were found to propose the application of blockchain but without publicly presenting a business process in detail. The found gaps that are directly related to the research questions that were formulated in the first chapter are:

1. *Absence of a business process model which depicts and analyses in detail the physical trading process between a buyer and a seller and the associated interactions within a multi-organizational network. Hence also absence of a detailed process model depicting the international trading of crude palm oil which is the chose business case.*
2. *Lack of literature that classifies blockchain applications which are suitable for the supply chain domain.*
3. *Absence of a full re-engineered end-to-end process that integrates blockchain.* It was further a noticeable scarcity of a case studies that reengineer parts of business processes where the technology is introduced and under-research of the whole BPM domain in combination with blockchain.
4. *Scarcity of literature that quantifies the benefits that blockchain can bring in a business processes* and lack of literature that translates the benefits of such a solution to monetary value.

Each literature gap has one-to-one correspondence with the research questions of this thesis. The first three identified gaps are addressing the three sub research questions that were formulated in chapter 1 while the fourth gap addresses the main research question.

In the next chapter the methodology for responding to each research question so that the research objective can be met will be described whereupon the consecutive steps that need to be taken within the next chapters will be presented. In the final chapter (Chapter 8), the author will reflect on whether and how the literature gap has been filled.

CHAPTER 3: Methodology

In this chapter, the research questions together with the methodology that will be followed in order to reach the research objective will be illustrated. First, the research questions that were considered will be presented. Second, the research strategy that will be followed throughout the report will be explained. At the end of this chapter, the related data collection methods and tools that were used in each chapter are explained.

3.1 Research Questions

The following research questions (1) (2)(3) and sub-questions (a, b, c, d, e) will contribute to reach the research objective mentioned in the previous chapter. The main research question (What kind of benefits can the application of blockchain technology bring to the inter-organizational business process of physical palm oil trading in Cargill?) will be answered by answering each of the 3 research questions and by evaluating the final design. A summary of those questions together with the different methods used to tackle each of them can be found in the table 1 below.

Table 1: Overview of methods used in answering each research question

RESEARCH (sub)QUESTION:	METHODOLOGY:
(1) What are the bottlenecks & improvement opportunities in the current business process of physical trading of CPO in Cargill?	Business Process Analysis & Workshop(s)
a. How is the Business Process of Physical Trading of Crude Palm Oil (CPO) currently being executed within Cargill?	Actors workshop, Desk research, Follow-up interviews
b. How does the current process perform and what KPIs can be used for measuring the performance of the process?	Quantitative analysis, Qualitative Analysis, Data Collection, Interviews
c. What can be said about the alignment of the business process (operational level) with the business model (tactical level) and strategy (strategic level)?	Interviews, Secondary Data Analysis, CANVAS Business Model
(2) What kind of Blockchain Applications are suitable for the Physical Trading of Crude Palm Oil?	Literature Review
d. What kind of applications currently span the Blockchain and Supply Chain and/or Business Process environment?	Synthesis Matrix & Extended Literature Review
e. How can those applications be categorized	Literature Review & Own Suggestion
(3) How can the Business Process be re-designed once the blockchain component is introduced?	Re-engineering Analysis, Interviews & Extensive Literature Review
MAIN RESEARCH QUESTION: What kind of benefits can the application of blockchain technology bring to the inter-organizational business process of physical palm oil trading in Cargill?	

3.2 Design Science Research as the research strategy

The design science research (DSR) approach will be adopted throughout the thesis. This method emerged from the Information Systems (IS) as an effort to provide a pragmatic research paradigm, promoting the creation of **artefacts** so that real life problems can be solved (Simon, 1996). IS can be found in multiple disciplines such as computer science, management, system theory, sociology, finance, economics and anthropology.

In DSR, there are two processes involved – namely *building* and *evaluation* – and four kinds of possible design artefacts, that is, *constructs*, *models*, *methods*, and *instantiations* (March & Smith, 1995). In this research, “model” was chosen as the artefact and more specific the model is considered to be the **design of a new business process**.

3.2.1 Motivation for applying Design Science Research

In a nutshell, this method is used when IT artefacts need to be developed and evaluated in a cyclical way and are suitable for solving organizational problems. It was thought to match perfectly with the research objective which was the design and evaluation of a new business process that would be supported by blockchain technology.

DSR is commonly adopted in IS research and digital innovation. Information system (IS) is an integrated set of components organized in a system that enables collecting, organizing, storing and communicating data. In an interorganizational supply chain, information systems are of a great importance and include the complementary networks that people and organizations use for collecting information in order to store, process or distribute data.

The exploratory stage of blockchain technology and the opportunities for developing interorganizational information systems in international physical trading of commodities were the leading reasons that this method was chosen. IS are of major importance in international trading where corporations may use such systems for executing and tracking their operations. Interacting and sharing information with partners or customers real time, can give them the opportunity to gain a competitive advantage in the market.

For the needs of this research it is proposed to adopt a design science approach that would aim to extend the boundaries of the current capabilities of an organization by designing innovative artefacts. By adopting this approach, a clear conceptual framework that will help understand, execute and evaluate the research will be provided.

3.2.2 Description of the chosen DSR approach

More specific, in this thesis the approach will be based on the process presented by Kuechler and Vaishnavi (2008) which includes the five phases; namely: i) awareness of the problem, ii) suggestion, iii) development, iv) evaluation and v) suggestion. The relevant conceptual model of the Design Science Research process as presented by its originators can be seen in Figure 9.

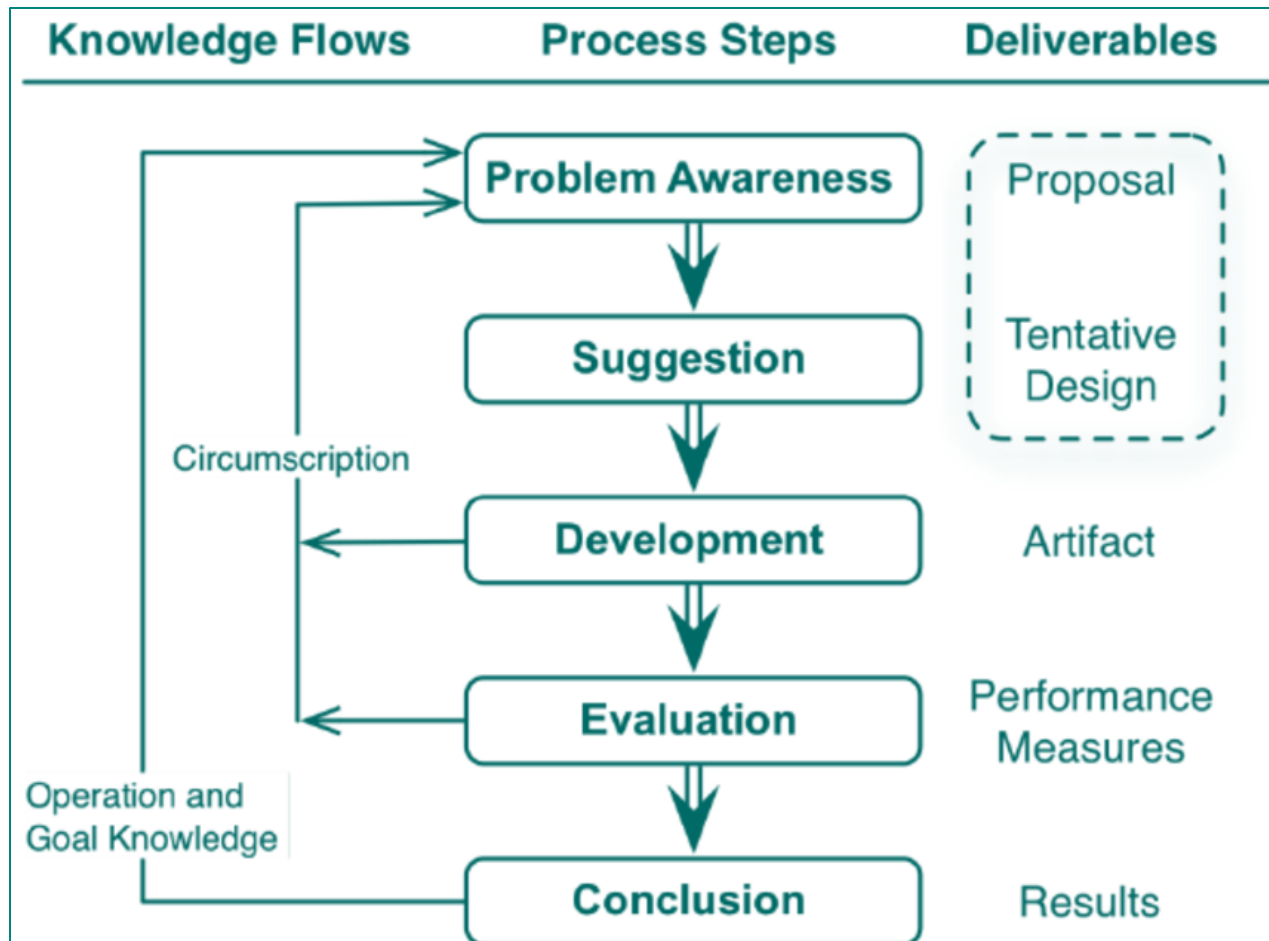


Figure 9: General Methodology of Design Science Research as presented by Vaishnavi & Kuechler (2004)

Description of the steps that were adopted in this research and their explanation with respect to this work can be found in the next page.

i) Problem (Awareness): a research problem can be realized from several different means such as a technological breakthrough. Here, the problem is identified and a proposal for a new research emerges.

In this step literature research, expert interview and workshops sessions were used as tools that would contribute to identifying the problem at stake.

ii) Suggestion: a creative step whereupon a functionality is envisioned based on a novel configuration of new elements. The output is the objectives for the solution and a tentative design.

In this step, suggestions emerging from the process' actors, the author's evaluation through business process analysis tools and the capabilities of blockchain is brought together in one solution space.

iii) Development: it includes the design of the artefact itself which is initially based on the tentative design and the solution objectives that were defined earlier.

At first, the artefact will be a result of creativity and intuition. However, during this phase, tools originating from Business Process Management will be used to structure the ongoing development. The design is the result of various cycles in which the case and literature were used to develop and improve the architecture (rigor), and in which stakeholders were involved (relevance) through workshops. In this way, we could verify and refine the fit of a constructed artefact in a specific case.

iv) Evaluation: once the artefact is constructed it will be evaluated against the criteria that emerged from the problem and the solution objectives. At this phase hypotheses can be made about the way the artefact (ie the re-engineered business process) is expected to behave and whether the defined requirements are met.

The design might be subject to change if the evaluation indicates that it has to be revised and various cycles might take place until the final proposed design.

v) Conclusion: once the design is final, the results can be summarised and communicated.

3.3 Research Framework

The goal of this research is to analyse a specific business process; namely the physical trading of crude palm oil within Cargill and redesign it by integrating blockchain technology. In the previous section, the steps involved in DSR were presented. The upcoming chapters will be structured upon the DSR approach, where each chapter is corresponding to each DSR phase.

The research framework in Figure 10 depicts the sequential tasks that will be completed in each DSR phase. The chapters corresponding to each step and the associated research questions are also depicted in the scheme.

First, the organization's landscape together with the business process will be analysed. This will provide an insight into the way the organization is currently operating, where the researcher will be able to reflect on the current process and identify bottlenecks. Second, a suggestion for a new design will emerge. This suggestion will aim to address the earlier identified bottlenecks and will be based on blockchain capabilities. Third, a new business process that will incorporate blockchain solutions in its design will be developed based on the suggestions.

Next, the business process will be evaluated and compared with the status quo. During this step, the new process performance will be assessed where the potential benefits will be quantified. Technological feasibility and alignment with the organization's business model and strategy will also be taken into account. The input and points raised by the process' actors will also be considered while the suitability of the chosen industry will be assessed.

At the last step, the researcher will propose a roadmap for adoption of such a process and overall conclusions will be drawn.

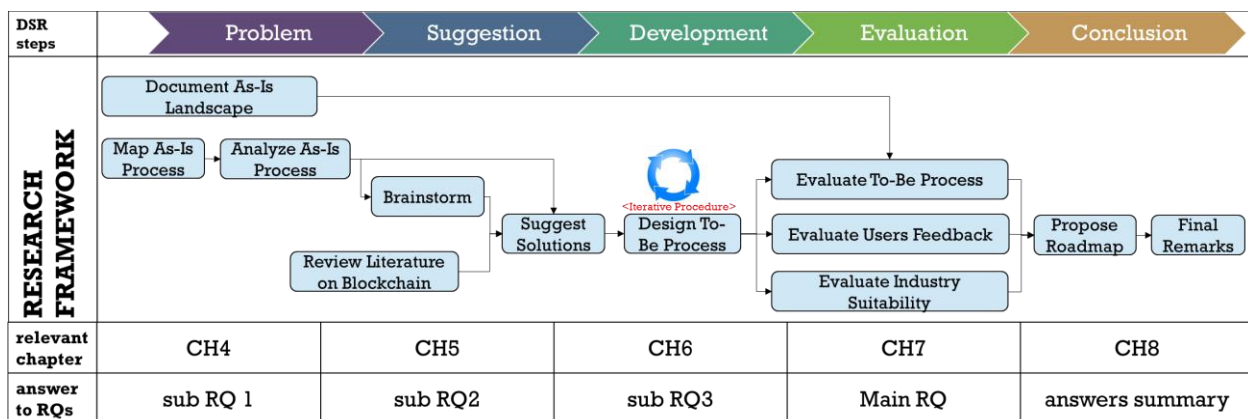


Figure 10: Research Framework structured according to DSR approach

3.4 Tools & Data Collection Methods

As mentioned in the previous section, the DSR approach will be adopted where each of the forthcoming chapters will correspond to a DSR step. In this section, the tools and data collection methods that were used in each chapter will be described.

3.4.1 Tools & Data Collection Methods of Chapter 4 (PROBLEM AWARENESS)

In order to map the current state of the business process, mapping the surrounding landscape was considered to be as important as mapping the actual business process. A summary of the relevant tools and data collection methods used in this step are described in Table 2.

Table 2: Summary of Methods & Tools used during the As-Is Mapping

DATA COLLECTION METHODS:	TOOLS/TOPICS:	
A. Documenting the Landscape		
Internal Secondary Data Collection	Vision, Mission	Strategy
Multi-stakeholder Workshop 1	CANVAS Business Model	
B1. Mapping the Business Process		
Multi-stakeholder Workshop 2	SIPOC diagram	Flowchart
B2. Analyzing the Business Process		
Business Process Analysis	Value Added Analysis	Waste Elimination
Business Process Analysis & F2F Interviews	KPIs identification	Time Estimation

A. Tools & Data Collection Methods used for Documenting the Landscape

The ability to rethink processes in a cross-functional way increases the probability of success when it comes to changes (Fagan, 2006; Weerakkody, Janssen, & Dwivedi, 2011). Mapping the surrounding landscape of the process prior to its re-design is considered to be vital since considering the social, organizational and technical challenges encompassing its landscape need to be well-thought-out in order to achieve a successful transformation (Horton & Wood-Harper, 2006).

In order to map the organization's landscape, the vision and mission of the chosen company was first described. Next the tactical and strategic level was assessed so that it can later be compared with the business process with portrays the operational level of the organization. Information on the company's strategy was collected through internal sources while the business model was built for the first time in this report in a Multi-Stakeholder Workshop setting. The Business Model tool that was used, together with the way information was collected is described in the next section.

Business Model Design (CANVAS as tool & Workshop as Data Collection Method)

Crafting the organization's business model contributes in realizing what differentiates it from competition and shows the alignment between internal and external stakeholders on the way the purpose is achieved (Casadesus-Masanell & Ricard) . It is therefore important to understand the business model before fitting any kind of business solution (process/data/technology) to operationalize the business (Ujwary-Gil & Potoczek, 2016). Once the business model is analyzed, it is possible to reflect on and determine whether it is compatible with the strategy (Kettinger & Teng; Teece, 2010) or how it aligns with the business process (Bask, Tinnila, & Rajahonka, 2010; Solaimani & Bouwman, 2012) .

The business model CANVAS (Osterwalder & Pigneur, 2010) was used for this matter since it is a tool which is widely accepted by the academic world while it is popular in organizations since its concept is easy to grasp. The CANVAS model consists of 9 building blocks and cover four main areas in business, namely: customers (who), offer (what), infrastructure (how) and financial visibility (how much). Those building blocks of the model are presented on the Figure 11 below.

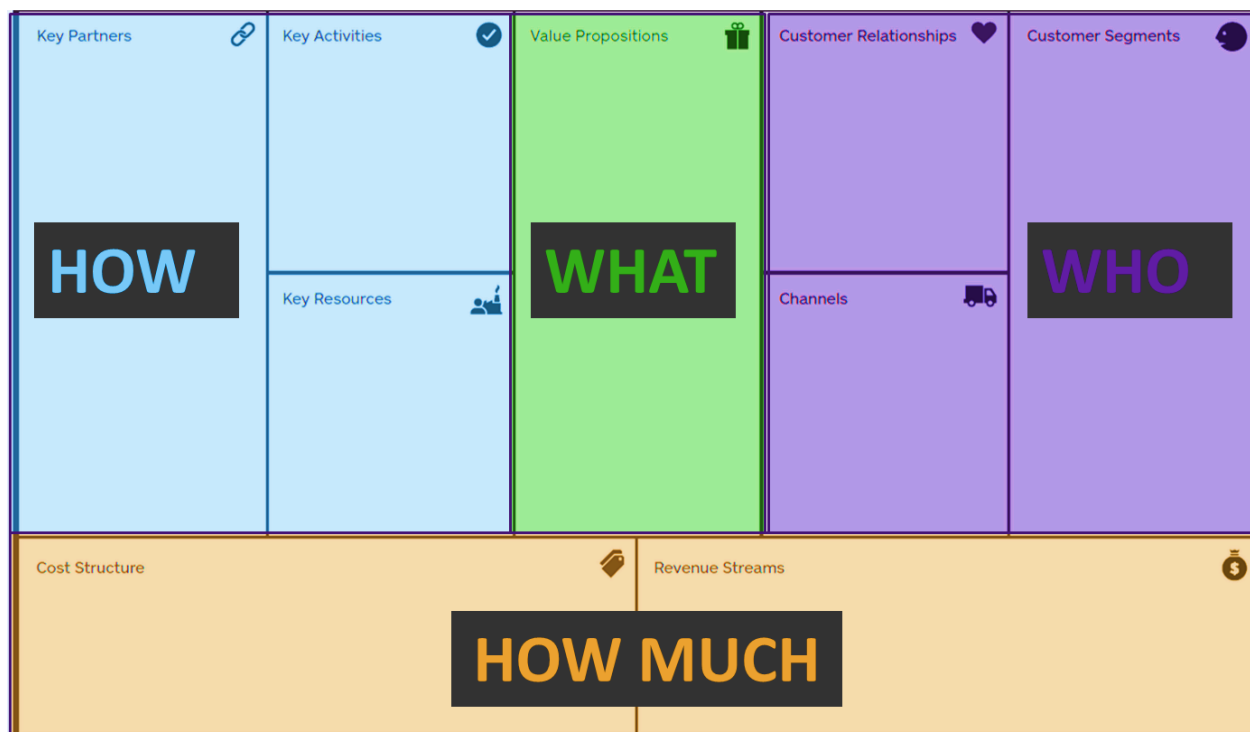


Figure 11: The 9 building blocks on the CANVAS Business Model as proposed by Osterwalder and Pigneur (2010)

The business model describes the way an organization creates, delivers or captures value and it includes:

- roles and relationships of a company, its customers, partners and suppliers
- flows of goods, information and finances between these parties
- main benefits of those involved

In order to design the CANVAS business model, a **multi-stakeholder workshop was facilitated**. The workshop lasted few hours and the chosen contributors covered several functions of the organization that were considered to be relevant with the 9 building blocks of the model. The participants were guided by the facilitator and the guidelines from Osterwalder & Pigneur's (2010) were followed throughout each of the nine steps. Input was provided in each block and results were recorded step by step on a printed CANVAS. At the end of the session, the results were summarized and additional remarks or corrections were made. The captured CANVAS was then used as a guide to capture more information on internal documents where few secondary resources were used to explain the Business Model in more detail.

B1. Tools & Data Collection Methods used for Mapping the Business Process

The as-is process under scrutiny was not available in literature or internal company documents. The description of such a process had to be built for the first time in this research. The involvement of the most crucial stakeholders was therefore necessary to ensure that the process is accurately described and a multi-stakeholder workshop was considered to be the most suitable method for this matter. The tools used during the workshop was a SIPOC diagram for identifying all relevant elements in the process and flowchart diagrams as a way to map the process and communicate the result.

Data Collection Methods for Mapping the Business Process

As mentioned above, a **multi-stakeholder workshop** was thought as the most efficient method to map the business process. The workshop took one working day where the participants were guided through a process mapping session. The workshop's participants list can be found in Appendix 4.

First, the sub-processes related to physical CPO trading were identified between the buyer and the seller of the product. At this level of analysis, a SIPOC diagram was created as a tool to identify

the roles, inputs and outputs at a high-level process. This served as a starting point towards creating a detailed process map.

Next, a more detailed process diagram was initially captured in a brown paper session. The process was designed in swim-lanes, where physical, information and financial flows together with related actions and actors were documented. The participants were freely exchanging information and they collectively built the full process diagram with the help of the facilitator.

The use of brown paper played a catalytic role at this stage. During the workshop it served as a communication tool and helped the participants stay in track throughout the workshop. After the workshop, the brown paper was used as an input to design a flowchart in Visio.

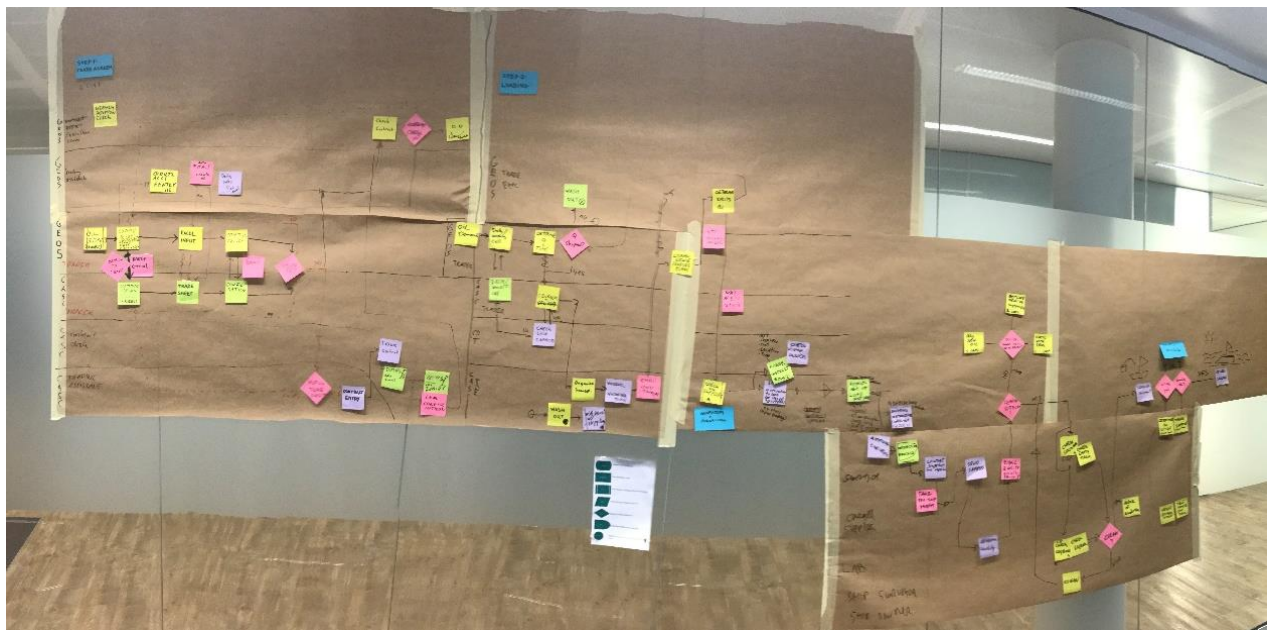


Figure 12: Part of the mapped process that was captured during the workshop session

The involved actors were contacted in a **follow-up session to evaluate the designed flowchart**. The process that was earlier described was presented in a flowchart in swim-lanes and the session's goal was to evaluate the accuracy of all processes that are taking place and to ensure that the abstraction level of those processes was sufficient. Next, all information was used to correct the flowchart and write a storyline behind the process. The flowchart and storyline were communicated and evaluated once more with the participants via an e-mail and minor corrections were further made.

Tools for Mapping the Business Process

The **SIPOC diagram** is a tool commonly used in the Six Sigma methodology (Soleimannejed, 2004) in order to have a high level overview of the process during the define phase of the DMAIC process (Pyzdek, 2003; Vanzant-Stern, 2012). In this step, it was used as a starting point to identify roles, inputs and outputs at a high-level process. This tool helped to show the scope of the potential project, give an overall view of the process including inputs and outputs and identify key suppliers & customers. It therefore comprises the first step in understanding the process and it can be considered as the starting point towards creating a detailed process map.

SIPOC stands for:

Suppliers: WHO provides Inputs

Inputs: WHAT goes into the Process

Process: HOW is the Process Performed

Output: WHAT comes out of the Process

Customers: WHO receives Outputs

During the workshop, steps for making a SIPOC map were described to the participants through an example and they were then guided to design the process' SIPOC. The following steps were taken consecutively for designing the SIPOC diagram:

- a) Identify process steps: participants were asked to use 5-10 steps maximum in order to describe the process in a high level. The steps were listed sequentially and action verbs were used.
- b) Identify Outputs: participants were asked to list the outputs of the process by using nouns and to include both physical objects as well as information.
- c) Identify customers: participants were asked to list any stakeholder that receives an output - either product or a service- from the process.
- d) Identify inputs: participants were asked to list any inputs of the process by using nouns and to include any physical object, information or factors that can influence it.
- e) List suppliers: participants were asked to list any person or organization -either internal or external- that provides an input to the process.

After the SIPOC design, the participants were asked to describe each step of the process with the help of the facilitator while the result was mapped live in a **brown paper session**. The final outcome was translated by the author into a **flowchart** in Visio software.

B2. Tools & Data Collection Methods used for Analysing the Business Process

The full business process was earlier mapped and a flowchart together with a brief description of the process was available. In order to realize the problems that the current business process entails, the mapped process was further analyzed. First, a **value added analysis** was tabulated where all activities were classified to value-adding, non-value adding and business value adding. Then, a qualitative analysis was performed where the **time** needed for chosen actors to perform certain steps was estimated. **KPIs** were also proposed after consolidating relevant experts. It was then considered that sufficient information was collected, the current business process was assessed and conclusions regarding the identified bottlenecks could be drawn.

3.4.2 Tools & Data Collection Methods of Chapter 5 (SUGGESTION)

The flowchart input from face to face interviews and the brainstorming session contributed in drawing a **Critical to Quality (CTQ) tree** which aimed to derive specific requirements from general needs and capture the voice of the customer (Basu, 2014). CTQ trees are common measurements in the Six Sigma process improvement method and is widely used as a way to consider the actor's requirements and expectations before the re-design (Thomsett, 2005).

Next, an **extensive literature review** was performed in order to collect and categorize all relevant applications that are suitable in the Supply Chain domain. Applications were then organized in a **synthesis matrix** where evidence from different sources was presented. Inspired by literature, concepts were grouped in 3 categories and 2 subcategories. The solutions that blockchain can bring when then matched with the problems that were identified with in the previous chapter. This was considered to be the basis of the development phase which followed in the next chapter.

3.4.3 Methodology & Iterative Steps of Chapter 6 (DEVELOPMENT)

This chapter was considered with the design of a new business process that could solve the identified bottlenecks by integrating blockchain functionality in its design. Business process re-engineering requires creativity, innovation and radical thinking and a systematic approach for re-design is necessary (Van den Berg, Franken, & Jonkers, 2008). During the re-design, the suggestions from the previous chapter were used while each process step was examined separately.

However, it is argued that there is no mechanical way to proceed from requirements to an ideal design (Simsion, 1994).

While there is no method to assess whether a given design is the best possible, this report attempted to assess the completeness of the new design by performing several iterations and an agile approach was adopted throughout the chapter. First the researcher created a first design. Next, the design was discussed with a continuous improvement expert and with at least one actor representing the specific process step that was under revision. After the two iterations, corrections were made and the design was assessed once more by several experts so that the completeness of the design can be assessed.

In order to determine the completeness of the reengineered business process, a **Multi-stakeholder feedback discussion** took place. Stakeholders which are involved in the process participated in the discussion where they assessed whether all necessary activities were included while they also mentioned the actions that could be considered optional and can be omitted in the new design. Corrections were then made whereupon a final design emerged. The design was then considered to be complete and conclusions could be drawn regarding the new artefact.

3.4.4 Tools & Data Collection Methods of Chapter 7 (EVALUATION)

After the business process re-engineering step the new process had to be evaluated. A summary of the relevant methods and tools used in this step are described in Table 3.

Table 3: Summary of Tools & Data Collection methods used for evaluating the new business process

METHODS:	TOOLS/TOPICS:
Business Process Analysis, Interviews	Expected Benefits & Drawbacks
Multi-stakeholder Feedback Discussion	Evaluating the applicability of the new model
Literature Review	Evaluating the Industry's Suitability
Literature Review, Interviews, Evaluation Results	Proposed Roadmap for adoption

The contents and involved actions of the new process were assessed by the stakeholders and concerns regarding its applicability were raised. Next, in order to quantify the benefits, the time savings of the new design were estimated. The business process was further put against the strategy and business model in order to draw conclusion regarding the alignment between the operational, strategic and tactical level. An evaluation of the chosen industry was also made. The evaluation of the model was then considered to be complete and final conclusions could be drawn.

CHAPTER 4: PROBLEM identification of the current business process

Following the design science research approach, the research starts with identifying and describing a problem of practical relevance (Herver, March, Park, & Ram, 2004). Here, the aim of this chapter is to collect all relevant information regarding the overseas trading of crude palm oil and analyse it so that the problem at stake can be better understood. The coloured areas of Figure 13, indicate the steps of the research framework that will be covered in this chapter.

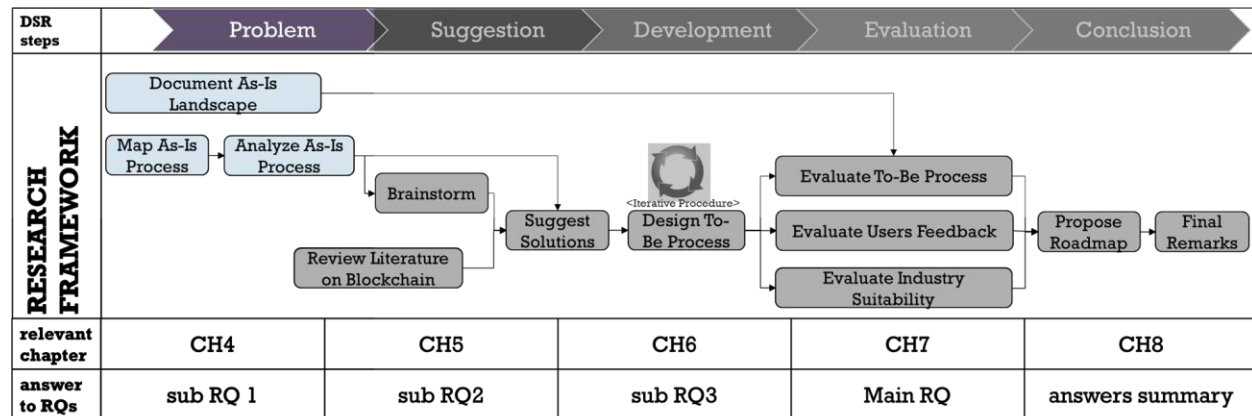


Figure 13: Description of the chapter's framework according to the report's Research Framework as presented in the Methodology

In order to have a successful new design, a spherical view of the current situation is important where literature review, involvement of the practitioners and use of relevant modelling techniques are vital activities (Ostrowski, Helfert, & Hossain, 2011). This chapter will provide such a multidimensional analysis. First, the surrounding environment of the process at an organization level will be presented. Next the actual business process depicting all actions required for an overseas trading of crude palm oil will be mapped. At the end of this chapter, the processes and associated stakeholders according to the chosen unit of analysis will be underlined and further analysed. The identified issues will be presented at the end of this chapter. Those steps are in accordance with the earlier mentioned research framework and are illustrated in Figure 13.

The chosen case

The way commodities are traded either physically or financially is expected to change within the next coming years where digitization will have a leading role (Belt & Boudier, 2017). The supply chain in commodity trading requires the collaboration of several different actors such as brokers, banks, customs, inspectors, insurers, shippers and freight forwarders. As an example, it was found by Maersk in 2014 that a simple shipment of refrigerated goods can go through nearly 30 people and organizations, including more than 200 different interactions and communications

among them (2018). All parties are required to have access to different kind of information and are responsible for completing a different process of the trading. It is argued that trafficking of physical commodities within a blockchain solution can solve several issues and reduce costs significantly (PwC, 2017)

For the needs of this report, **a representative business process that would demonstrate the way physical trading of commodities are currently executed was required.** This business process would provide a baseline from which improvements can be measured and will be used in the next chapter as a key to identify and localize (blockchain) opportunities of improvement. **The suitability of the chosen process will be evaluated in Chapter 7.**

The preliminary literature review in the introduction chapter, showed that physical trading of edible fats and oils is a process which is usually regulated under standardized contracts created by the FOSFA trade association. The rules to be followed are standardized and stipulated in those contracts and affects the way the business process is executed. However, even though such contracts were found, a description of any commodity trading business process under FOSFA rules was not available in literature. Hence, the description of such a process had to be recorded for the first time in this report.

The chosen business process was the physical trading of crude palm oil where a FOSFA 80 contract is applied. Since no further public information was available, professionals involved in the process were invited to participate in a workshop and provide input. Details on the way the workshop was executed can be found in the related Methodology chapter whereas the results of the workshops will be in section 3.2.

The chosen actors

The process to further map and zoom in, comprises of the physical trading (space transformation) of crude palm oil between a buyer and a seller. The buyer and the seller are two units that belong to the Cargill organization and are treated as two independent entities. The seller is on the agriculture side of the supply chain while the buyer is specialized in refine oils.

It was thought that by choosing the two main actors that belong to the same organization, the exchange of information would be easier and no useful information would be withheld to protect proprietary information. In addition, since both entities are trading according to the FOSFA contract, it was thought that the business process would not deviate much from the way most of the organizations are trading with each other.

The report focuses on the midstream part of the process where palm oil is in crude form. The starting point is considered to be right after milling at a collection port (usually in Malaysia or Indonesia) and it ends right before refining where the product has arrived and is unloaded in shore tanks at the Rotterdam port in The Netherlands.

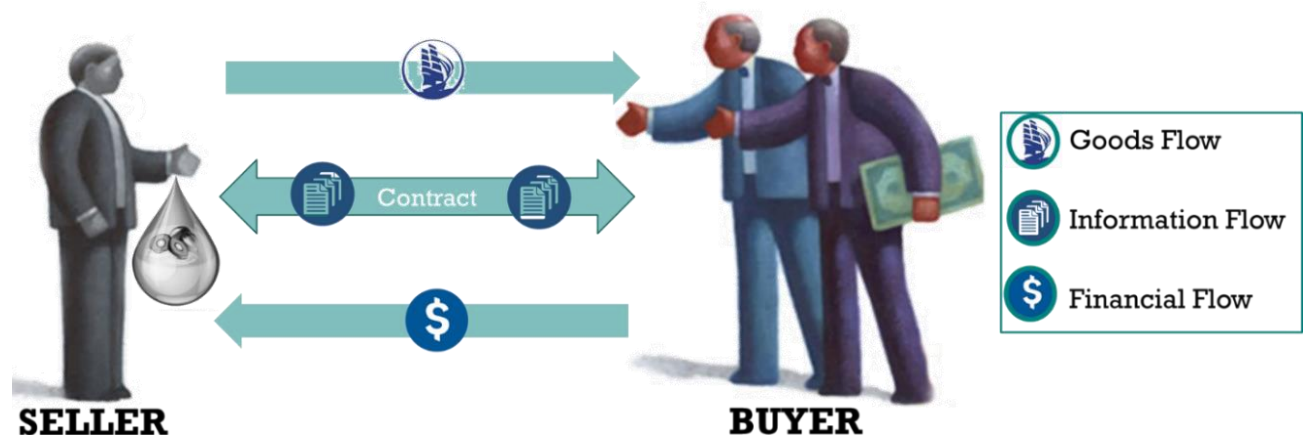


Figure 14: Highest abstraction when visualizing the Physical Trade of Crude Palm Oil, created by author

The process between the two entities with the highest level of abstraction can be found in the Figure 14. Here it is assumed that there is a deal for a specific product between a buyer and a seller whereupon a binding contract is attached to it. The buyer is accountable of delivering the product whereas the seller is due to pay for the service. Some of the conditions regarding the delivery and payment are stipulated in that contract. Therefore, there is a flow of goods from the buyer towards the seller, a constant flow of information between both parties and a payment linked to the delivered service.

The seller might not trust the buyer and ask for an upfront payment whereas the buyer might not trust the seller and request that the product is delivered prior to the payment. Since the exchange of money and goods cannot occur simultaneously, several rules are stipulated in the contract that guide the trading procedure along the supply chain. Due to the lack of trust from both sides, a secure trade finance mechanism emerged which ensured that the trade risk has been managed for both counterparties.

A more illustrative scheme representing the international trade “ecosystem” has been designed by the Boston Consulting Group (2016) and has been repeatedly used as a reference point in several reports during the past year. This scheme can be seen in Figure 15. Here, the intermediation of several actors is required and the below ecosystem emerged as a response that could protect both the buyer and the seller. At this model the information, goods and financial flows are depicted in the whole ecosystem. In addition, the financing as well as the risk mitigation flows are illustrated.

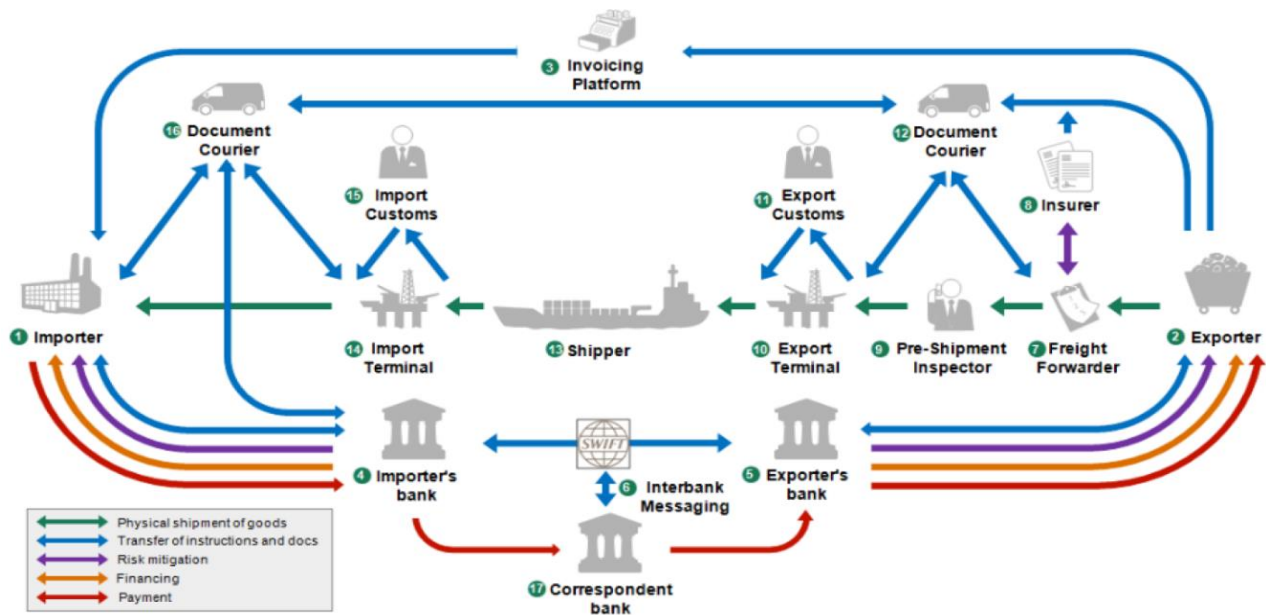


Figure 15: The international trade ecosystem (The Boston Consulting Group, 2016)

The actions of several stakeholders were taken into consideration during the mapping process while the analysis focus is set on the buyer and the associated interactions with the seller. More information can be found later in section 4.2.1.

4.1 Documenting the As-Is Landscape

The chosen actors belong in the same organization, namely Cargill Inc.. Cargill is an American private global corporation based in Minnesota and is operating in 70 countries, employing 155.000 professionals worldwide. It was established in 1865 and was initially affiliated with the trade, purchase and distribution of grain. During the years it expanded beyond grain and is now involved with the trading of several commodities, such as agricultural products, food ingredients & bio-industrial, animal nutrition, protein & salt, metals & shipping. An overview of the organization's value chain can be seen in Figure 16.

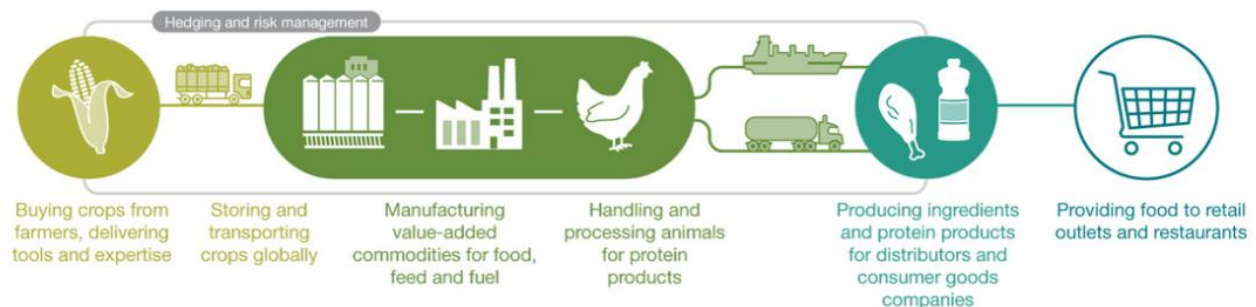


Figure 16: Cargill's Value Chain; retrieved from <https://www.caill.com/about/company-overview>

Mission, Vision and Corporate Values

Cargill's mission is to be the “leader in nourishing the world in a safe, responsible and sustainable way” (Cargill, 2017). The mission expands from feeding people to nourishing animals and involves safety on associated people and products whereas a commitment on sustainability is actively present.

The buyer's vision is to be “the most globally relevant and trusted partner in edible oil solutions”. This will be realized by building distinct capabilities and a culture that creates deep customer intimacy and value, enabling opportunities for healthier lives and sustainable growth. The vision acknowledges the organization's leading position in food and tries to respond to the growing interest of consumers for nutritious food by expanding its offerings.

The organization has a collective set of four explicit core values, namely: respect, integrity, passion and commitment to serve (Cargill, 2018).

4.1.1 Mapping the strategic level of the buyer

The buyer's strategy is considered to be confidential and is presented in PART A of the Appendices.

Here, three common generic competitive strategies which are commonly used by organizations will be presented instead. Those strategies have been proposed by Treacy and Wiersma (1995) and include three value disciplines:

a) **operational excellence**: refers to the production of a reliable product at a low cost which offers convenience and easiness to use. Here, the role of logistics optimization is dominant.

b) **customer intimacy**: offering the best customer solution and offer innovation at customer level which increases customer loyalty. Here the customer relationship management practices is an important aspect.

c) **product leadership**: offering a product of the best quality, which is highly innovative while its production is flexible. The role of innovation as well as research and development is crucial

It is suggested for organizations to be a leader in one of the three strategic themes while performing to an acceptable level the remaining ones.

4.1.2 Mapping the tactical level of the buyer

As explained in Chapter 3, the business model was crafted in a multi-stakeholder workshop session. The business model describes the way an organization creates, delivers or captures value. The approach from Osterwalder and Pigneur (2010) was followed where the nine building blocks that are depicted in the figure 17 (next page) were considered.

More information regarding the methodology and the data collection method is available in the related methodology chapter. At the end of this section, a simplified CANVAS Business Model is presented in Figure 18.

The business process is related with the transportation of crude palm oil while the buyer is transforming the oil to several different products and blends. Therefore, the **business model of the buyer's palm oil (refined) products** was captured.

The buyer offers a broad portfolio of refined palm oil products and there are 4 associated customer segments. The value proposition offered to the customers is included among others high risk management, dedicated solutions and products which are transparent and highly traceable up to the planation. Channels include direct ordering, distribution of products, dedicated local teams

which can reach out the customers and with the organization of dedicated events. The relationships with the customer are maintained through regular communication, company visits and with several partnerships. Profits include revenues from the product sales, revenues from offered services and revenues from trading. In addition, key activities are associated with refining, logistics, planning and trading. Key resources are related with the ownership of assets and integrated supply chains together with a vast network of experts. The organization is partnering with logistics providers, suppliers, distributors and branch organizations such as FOSFA. Last, the costs incurred are among others the maintenance of plants, R&D and labour cost.

The full Business Model is considered to be confidential and it is presented in PART A of the Appendices. A more detailed explanation of each building block is also available in PART A.



Figure 17: The 9 building blocks of the CANVAS Business Model

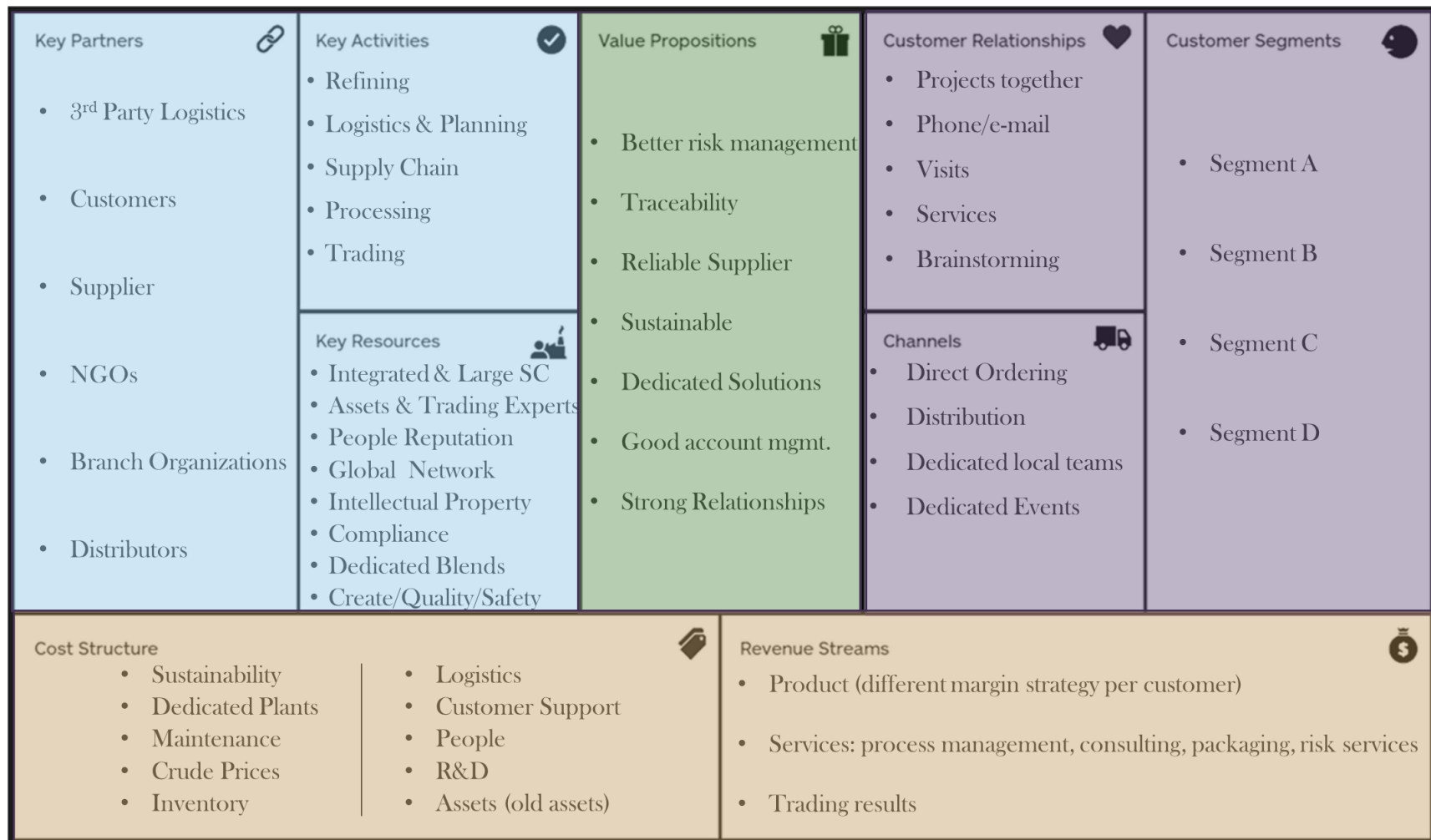


Figure 18: CANVAS Business Model of Palm Oil Products for the Buyer (public version)

4.2 Mapping the As-Is Business Process (operational level)

In order to map the as-is business process, a multi-stakeholder workshop was organized in order to collect all the relevant information. In total 12 experts participated in the session and their specialty covered several functions of the process such as finance, trading and contract execution. The full list of the stakeholders can be found in Appendix 4. Information regarding the data collection methods and explanation of the tools used in this step was presented earlier in Chapter 3. Here, only the outcome of the workshop will be presented.

First, a consensus was reached with respect to the sub-processes related to the physical CPO trading where five consecutive steps were identified as the main phases in physical trading. The level 1 map depicting the physical trading of crude palm oil can be seen in Figure 19. The identified steps were: 1) trade agreement, 2) loading, 3) contract execution, 4) unloading and 5) finalization.



Figure 19: Level 1 Map of CPO's Physical Trading between buyer and seller

In the **trade agreement phase**, a trade of a commodity has been performed and confirmed between a buyer and a seller. Next the exact volume to be shipped is decided and the **loading** starts only after the product's and tank's quality requirements are met. The vessel can sail as soon as loading is done given that the loaded volume and quality has been determined and all associated documents have been collected and approved. The third phase is the **contract execution** where documents needed for the provisional payment are sent to the buyer. Furthermore, actions related to planning the upcoming arrival of the product to the port of destination are performed. Upon arrival, the quality of the product as well as the condition of the shore tanks where the oil is about to be discharged are evaluated. The **unloading** can then take place while samples are constantly taken. During **finalization**, the final payment is determined based on the commodity's quality and final weight.

Next, the SIPOC diagram based on this map was created during the same workshop and it can be seen at Figure 20. As described in the methodology chapter, the **SIPOC diagram** was used as a way to identify roles, inputs and outputs at a high-level process and was used as a starting point towards creating a detailed process map. Apart from the buyer and the seller, the most important stakeholders were considered to be the oil supplier, the quality lab responsible for the quality analysis of the product, the transportation team responsible for planning the

shipment and the buyer's and seller's banks. It is required for the process to be in accordance with international trading rules, and both importer's and exporter's regulations. Therefore customs, port authorities and the government was considered important. In addition, following the industry's (market) rules was considered vital and hence requirements related to quality of the product were included.

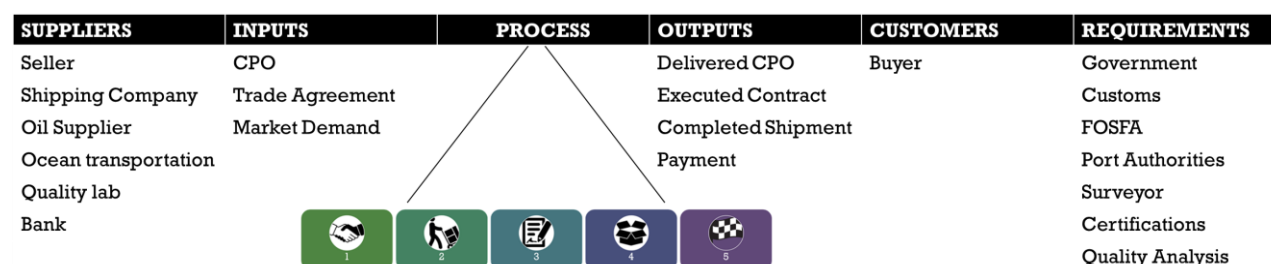


Figure 20: SIPOC diagram of the Level 1 Map of Physical CPO trading between buyer and seller

4.2.1 Business Process of Physical CPO trading

The input for designing the process flow diagram was collected during the workshop where the related actions performed in each sub-process were identified. The actions were drawn in swim-lanes so that the interactions between parties can be immediately observable. The method for collecting this kind of information can be found in the methodology chapter and the process diagram that was designed can be found in Appendix 1. In this section, the summary of those processes is presented here. In total 23 actors were considered and more than 65 interactions between them were mapped. A list of the **actors that were considered during the mapping of the business process can be seen in Table 4 while the focus was on the buyer and the associated interactions with the seller.**

Table 4: Actors that were identified in the process and in red the thesis focus (public version)

external	Port of Departure	Other Parties	Port of Arrival
	Surveyor SG	Ship's Master	Surveyor NL
	Independent Lab SG	Shipper	Independent Lab NL
		Courier	Customs NL
internal	SELLER	Cargill (Port Activities)	BUYER
	Trader	Transportation Team	Trader
	Admin 1	Buyer's Planning Team	Admin 1
	Admin 2	Buyer's Unloading Team	Admin 2
	Admin 3	Buyer's Lab	Accounting
	Accounting	Buyer's Inbound Planning	
		Buyer's Food Safety Team	

Process step 1: Trade Agreement

This step includes informing related parties on the acquisition of the commodity, the confirmation between counterparties regarding the trade agreement and the “birth” of a trading contract. The trade is first agreed between the buyer’s and the seller’s traders and it is later on entered in the ERP systems and double checked by several administrators.

Process step 2: Loading

This step includes the decision of the buyer’s trader to request a physical shipment of the commodity. The trading plans are communicated among stakeholders where several actions such as washout or contract averaging need to be made. A washout does not include a product delivery and it is only regarding financial arrangements between sales contracts and purchase contracts (Williams, 2014). Contract averaging is a procedure where several contracts are averaged and merged into one. In this way, the administration tasks are reduced since input for one contract is entered each time in information systems.

After those activities, the seller provides the palm oil by ordering it through an external supplier. When the oil is under the seller’s possession, its quality is tested and evaluated. Once the commodity’s quality is approved, the vessel’s tanks are inspected. Given that both product’s quality and tank’s condition are sufficient, the loading can start under a surveyor’s supervision. Surveyor is signing the statement of facts (quality and quantity of product) and heating instructions are sent to the ship owner. The vessel can now start sailing.

Process Step 3: Contract Execution

This sub-process starts with seller’s Admin 2 desk receiving a tender from the shipper. Several trade execution processes are involved in this step. Official documents (such as an original Bill of Lading, Certificate of Analysis etc.) are exchanged between parties and are entered in different software systems. Arrangements for the arrival of the vessel are also made.

Process Step 4: Unloading

The unloading step starts once the vessel arrives in the Rotterdam port. The surveyor inspects the vessel, the product and the shore tanks where the oil is about to be stored. Given that the inspection finds everything in order, the buyer’s unloading team signs the pump-plan and unloading can start under a surveyor’s supervision. Throughout unloading, samples are taken and a quality analysis is performed once more! Official documents that include info on the analysis of the product such as the concentration of free fatty acids, oil’s moisture and impurities content and final unloaded weight is created and provided to the buyer’s trade execution desk.

Process Step 5: Finalization

This is the final step of the process. It starts with the buyer's Admin 2 desk receiving documents that include information on quality and quantity of the unloaded product. This information is important for the finalization step in order to settle on the last 2% of the payment. Depending on the shipped quality and quantity the final invoice will be created. The outstanding amount needs to be paid within 21 days of the final invoice.

As explained earlier, the process was described by several actors and input was captured in a brown paper session where actions were placed in swim-lanes. The full process was then drawn in the Visio software and the **flowcharts of all 5 captured steps can be found in Appendix 1 together with the full storyline of the flowcharts.**

A simplified version of the finalization step is depicted in Figure 21 where actors and associated actions and interactions among them can be visualized. The main actors in this step is the independent FOSFA surveyor who is responsible to report the product's quality and quantity, the buyer's and seller's admin parties who are checking the product's specifications and are approving the issue of invoices or purchase orders and the buyer's and seller's accountants who are responsible to settle the final payment during the time frame that is stipulated in the agreed FOSFA contract.

The finalization step will be used as an example throughout this report so that the analysis, suggestion and re-design chapters of the report can be better understood.

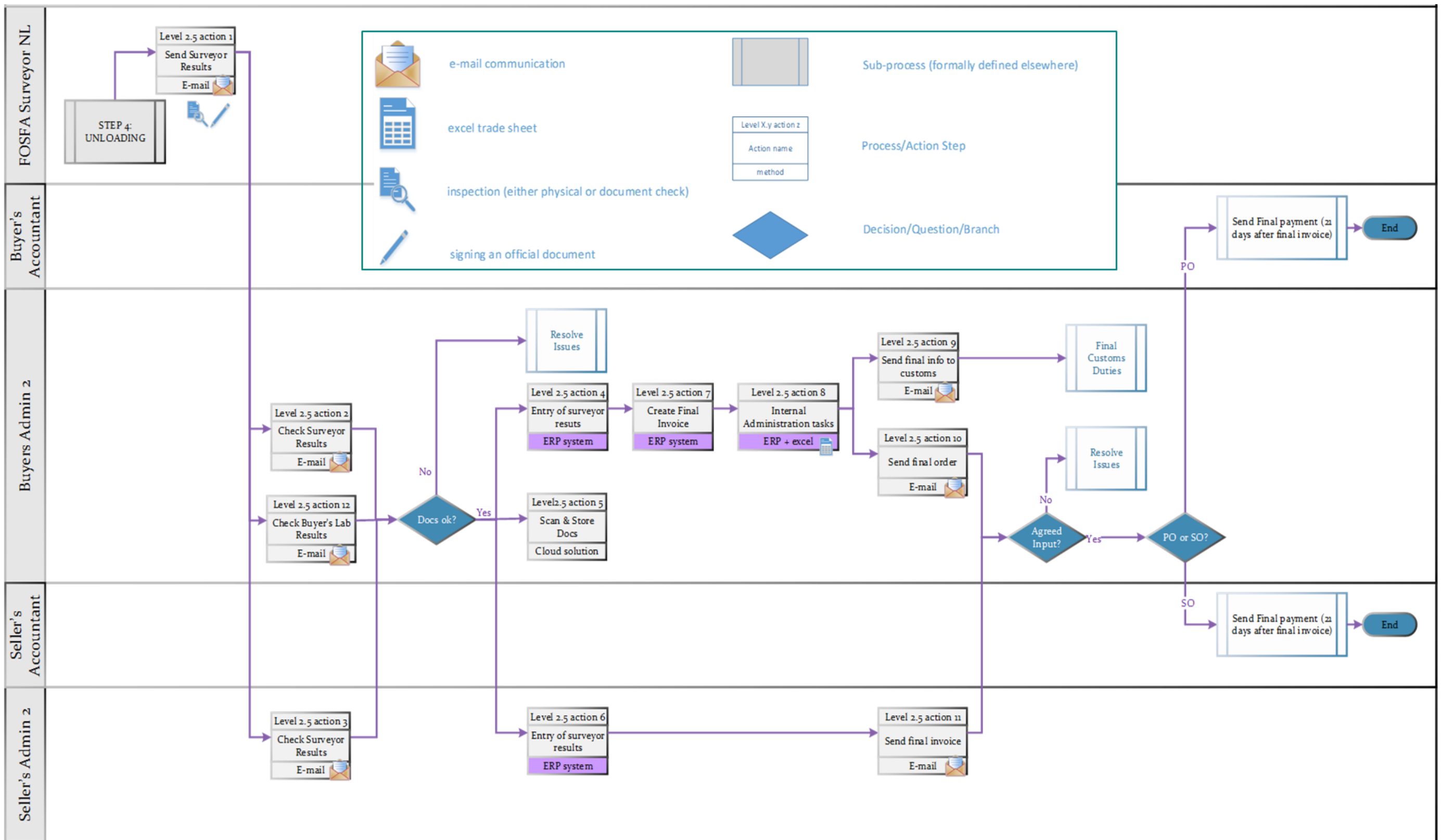


Figure 21: Finalization Step (simplified public version)

4.3 Analysing the As-Is Business Process

Based on an assessment of the information gathered during the workshops, interviews and primary data collection the existing process will be analysed. First the waste of the process will be identified and next, during the quantitative analysis the KPIs that are considered important for evaluating the case will be created while the estimated effort of the buyer and the seller will be presented in terms of time.

4.3.1 Qualitative Analysis: Value Added Analysis

The value added analysis is used in order to **qualitatively identify bottlenecks** in the process. This section focuses on identifying unnecessary parts of the process that could make the process leaner in case they are eliminated.

During the value classification, the actions of each step can be categorized as value-adding activities, business value adding activities or non-value adding activities (Dumas, Mendling, La Rosa, & Reijers, 2013).

In total, more than 70 activities were classified and an example of the value classification, presenting the findings for the finalization process step, is shown in Table 5. **The detailed classification of each activity can be found in Appendix 7.** Here, a summary of the findings and the logic behind the classification is described.

Table 5: Value Classification of the Finalization Process (Process 5/5)

VALUE CLASSIFICATION of Finalization Process (5/5)		
STEP:	PERFORMER	CLASSIFICATION
Send Surveyor Results	FOSFA Surveyor NL	NVA
Receive Surveyor Results	Buyer's & Seller's Admin 2	NVA
Check Surveyor Results	Buyer's & Seller's Admin 2	BVA
Enter Analysis in ERP	Buyer's & Seller's Admin 2	BVA
Scan & Store	Buyer's Admin 2	NVA
Invoice production related actions	Buyer's Admin 2	BVA
Send Invoice to Seller	Buyer's Admin 2	BVA
Final Info to Customs	Buyer's Admin 2	BVA
Check final Invoice	Seller's Admin 2	BVA
Forward Invoice to accountants	Buyer's & Seller's Admin 2	BVA
Receive/Check Invoices	Accountants	BVA
Request payment to a bank	Accountants	BVA
Open/Read Payment Request	Buyer's or Seller's Bank	NVA
Execute/Receive Payment	Buyer's or Seller's Bank	VA



- Value Adding Activities: activities that are actually contributing to the process on the first step were considered to be the capture of the trade and the determination of the product to be shipped. During loading, actions such as surveying, giving instructions to the shipper, signing

the statement of facts and eventually issuing the notice of readiness are all tasks essential for ensuring that the product is of a merchantable quality, the shipping conditions will not spoil the product and stipulates the way tasks should be done. Those actions are also the ones giving permission to the shipper to depart from the port of origin.

During contract execution, the discharge plan created by the surveyor together with the execution of the provisional payment were considered value adding activities. Next, during unloading, the surveying and analysis process is adding value given the fact that the buyer is paying upon the quality and quantity of the product. The actual unloading is also a value adding activity. Additionally, the execution of a payment is also value adding activity.

- Non-value Adding Activities: handover steps between actors such as sharing documents and exchanging e-mails are considered non-value adding steps. Communication between parties is also an NVA (eg. Communication between traders) while the result of it potentially be VA (eg. Determining quantity and timing of order). Waiting for documents to arrive to perform the next action are also evidently non-value adding steps.
- Business Value Adding Activities: all activities that are necessary for the organization to run smoothly as well as regulation related tasks are considered business value adding activities. Entering any kind of data in ERP systems, confirming actions, taking samples. Examining the product or checking documents is considered a control point and hence a business value adding activity.

Communicating quality results or forwarding an invoice to the seller or buyer might seem as a handover of tasks and therefore NVA. However, those tasks are mechanisms that contribute in quality control and payment, and hence listed as BVA.

Sending a purchase order or an invoice, serves to assure that a payment will be made, it is steps imposed by accounting and legal requirements (eg. FOSFA rules regarding payments) and will be considered business value adding activities (Dumas, Mendling, La Rosa, & Reijers, Value Added Analysis, 2013).

4.3.2 Quantitative Analysis of the As-Is Process

The process was never mapped before and quantitative records were not available. For the needs of this thesis, empirical estimations based on the actor's input were made.

After consulting with the process' actors, quantitative estimates of the time required for the buyer's and seller's administration processes were made. Those estimates will be compared with the new design in chapter 5 where the new business process is presented, as an attempt to quantify the expected benefits of the re-engineered process. The following process performance dimensions were chosen as relevant for the quantitative analysis of the process: cost, time, quality and flexibility (Dumas, Mendling, La Rosa, & Reijers, 2013). Those dimensions were then discussed with a supply chain expert and a continuous improvement expert.

Cost

In this report, the emphasis is put on the business process and a proposed redesign that will be more efficient. A right measure would therefore be one related with reducing the cost. Here, each process' costs are identified whereas the cost related with buyer's or seller's labour costs are listed under the time dimension due to the fact that they were quantified on a time basis.

During the trade agreement step, there are not many associated costs except for the labour force required in order to complete that step which is described later, under the "time" performance dimension. At the loading step, once the vessel is nominated, a lot of physical actions are performed involving loading, quality assurance before and during loading, and the actual ocean transportation of goods. Costs associated with quality assurance such as tasks performed by the surveyor and the lab are included.

The cost of those tasks is split between the buyer and the seller. Under CIF, the products are also insured by the seller which holds an extra cost while any related shipment and crew cost is also to be reimbursed by the seller. In some cases, pre-shipment and loading samples are also sent via courier to the country of destination which also hold an extra cost, both for the courier as well as the lab.

Contract execution, involves a lot of labour cost from administration activities which are mentioned under the time measure. In addition, the buyer's planning team is also occupied with actions that will ensure that the upcoming vessel can smoothly unload once arrives. Furthermore, physical shipment of documents via courier carry an extra unnecessary cost. Currently, 5 rounds of documents are sent via courier. In case all documents that are sent via courier are digitized,

around \$200 per vessel would be saved. This translates to \$1.6 million, assuming an organization is handling around 8.000 contracts per year. It is also has intangible benefits such as a more sustainable way of information sharing and faster and easier to analyse data. Moreover, a bank cost is involved during the provisional payment which in some cases is a speed payment which carries additional costs. When it comes to unloading, costs related with quality assurance and port operations (eg. actual unloading by the crew, unloading coordinator tasks, customs) are included. Next, during the finalization step the final payment (remaining 2% of the total payment) is executed as well as the final customs clearance. The costs that are described in this section has been summarized in Table 8 per process phase.

Quality & Flexibility

Trade Agreement is a flexible but inefficient step, since many manual non-value activities are executed for checking the input. It is a step where there is a lot of duplication of work as well as back and forth communication in order to confirm actions. There are occasions where the trade can be forgotten if not registered on time while sometimes the wrong information can be passed to the next actor. Passing wrong information from a trader to trade execution could include minor errors such as wrong contract, period, price or quantity and it was mentioned that it occurs approximately 10-15% of the total contracts volume.

Loading and unloading require compliance during the quality assurance step where the quality of the product is checked. The process is not optimized, but the fact that both buyer and seller belong in the same organization gives them the freedom to provide each other with more flexible agreements and also handle special requests (eg. number of multiple Bill of Ladings, extra analysis, vessel nomination option to avoid dead freight etc.).

Regarding contract execution, involved actors confirmed that several data (and many times the same data) are used as an input in several files and systems. This increases the possibility of mistakes and omitted files. On time payment of the provisional is one of the proposed KPIs. If all data are in one source, the time required to evaluate all needed documents would decrease and hence the chance to make on time payments would be higher. In addition, the fact that the buyer is waiting for the arrival of original physical documents reduces the quality of the process and make data harder to analyze. The execution of the finalization step is based on the rules that are stipulated on the FOSFA contract where the manual handling of information is increasing the potential errors.

Time

Throughput time is a criterion that is vastly used when analysing a process. In this case, the process includes many physical actions such as unloading and loading of the vessel together with the sea transfer of the goods. This procedure takes around 35 days and since it is governed by physical processes, is not considered to be a right measure for this business process.

Since the mapped process is mostly depicting administrative tasks, it was considered to analyse the processing time. This is the time that participants spend on performing tasks in order to handle the case (Dumas, Mendling, La Rosa, & Reijers, 2013).

The detailed effort estimated for each activity per step can be found in Appendix 8. A summary of the results together with the interpretation of the findings can be found in Table 6 below.

Table 6: Summary of Estimated Effort required from Buyer & Seller in each task (public version)

	Trade Agreement	Loading	Contract Execution	Finalization	Total Time
Buyer's Effort (% total time)	54%	7%	19%	20%	x mins 100% buyer's effort
Seller's Effort (% total time)	41%	23%	17%	19%	y mins 100% seller's effort
					TOTAL EFFORT: $x + y = 3.3x$ mins

In the first step, actual value adding is only 20% of the buyer's process. The rest of the time is equally divided among control points (matching of already agreed deals) and entering information to ERP systems. Buyer spends way more time due to the fact that the accounting and commercial ERP systems are not integrated and therefore data are entered twice. If they were, they would spend a comparable amount of time! Then still, the same would hold, most of the activities would still be related to checking documents and entering information to ERP.

Regarding loading, most activities are non-value adding. Most time spend on aligning on activities and copying information to ERP systems. It is worth mentioning that around 50% of each actor's time is spent on activities related to price averaging and splitting Bills of Lading in their ERP system which according to the actors is aiming to reduce the even more repetitive tasks that would result to even higher workload otherwise. Furthermore, the rest 50% of the buyer party's time is invested in business value added activities whereas the seller is investing time in organizing the

shipment which under CIF conditions, the seller's party is accountable for organizing the transport and delivery of the goods to the port of destination. Again, the seller burdens the cost of having two unintegrated systems, where 20% of the time is invested in copying information from one system to the other.

When it comes to contract execution and finalization, less than 10% of the time is about value adding activities such as executing a payment. The rest of the time is spent on control points, sending and receiving of information or entering details in ERP systems.

4.3.3 Proposed KPIs

In the previous section cost, time, quality and flexibility were analysed as performance dimensions of the process. From those dimensions that were discussed, relevant KPIs are proposed and can be found in Table 7. Each KPI is associated with at least one process step.

Table 7: Proposed KPI's for measuring the performance of each step

	PROCESS STEP				
PERFORMANCE	1 Trade Agreement	2 Loading	3 Contr. Execution	4 Unloading	5 Finalization
A. COST					
surveyor		✓		✓	
external lab & technicians		✓		✓	
internal lab & technicians				✓	
shipping & crew		✓	✓	✓	
customs				✓	✓
ocean transportation		✓			
demurrage				✓	
bank			✓		✓
shipping docs			✓		
B. TIME					
buyer's labour force	✓	✓	✓	✓	✓
seller's labour force	✓	✓	✓	✓	✓
lead Time		✓	✓	✓	
port activities		✓		✓	
goods shipping		✓	✓		
C. QUALITY					
# of admin errors	✓	✓	✓	✓	✓
% pay in time			✓		✓
# missing docs/info	✓	✓	✓	✓	✓
# of data sources	✓	✓	✓	✓	✓

4.4 Recap of Chapter 4

The strategy that was presented showed that the organization intends to modernize its processes and is willing to commit into fundamental changes. In addition, growth opportunities seem to be priority while actions that can enhance customer relationships will be considered. Therefore, the design approach of the **thesis which is reflecting on the process and revisiting to make it more efficient by the use of a new technology would be of an interest to the organization**. The revision of the design is directly related to the 1st and 3rd strategy areas; (see confidential appendix). In the case the new process can benefit the customer as well (eg. provide better visibility on the supply chain), the solution would also relate to the 2nd strategic area as well (see confidential appendix) .

The business model showed that the **product is not as commoditized as expected**; except for the product itself other factors such as product's traceability or proof that sustainable standards are enforced is as important. In addition, the buyer is adding value to the product by refining it but also by providing dedicated solutions or offering risk management which is a vital part of the product's value proposition. Furthermore, it was seen that several external and internal parties are interrelated during the involved activities and hence the **alignment and good communication among stakeholders (of sometimes different interests) should not be neglected**.

During the mapping of the current process, **23 actors were considered and more that 65 interactions** ² were shown in the flowcharts. Some of the interactions were repetitive between the same actors while there were actors that were not interacting at all with each other.

The qualitative analysis **identified NVA and BVA activities which is waste and should be considerably reduced**. Some activities could be eliminated by means of automation, as for instance the high volume of e-mails that is exchanged for passing over information to the right party. Furthermore, the control points (BVA) such as checking documents could be eliminated or decreased to the minimum. This would mean that a mechanism for not making mistakes at first place should be in place. Another approach which is more radical, is eliminating the actors

² If all actors were interacting with each other at least one time the resulting interactions would have been more than 250!

involved in the process so that the handover itself is reduced while the workload of the remaining actors is increased.

The quantitative analysis showed that both actors spend a **lot of time on non-value added activities** while the seller is spending extra time in administration not only due to the fact that the shipment has to be arranged with external partners but also because two non-integrated ERP systems are used. After all, when a CIF contract is agreed, the seller is obliged to organize the delivery of the product to the port of destination.

CHAPTER 5: SUGGESTION for developing a new business process

This chapter aims to first focalize in the blockchain applications that are considered to be suitable in supply chain management and next to draw the requirements for re-engineering from a user's point of view. At the last section, the requirements will be matched and blockchain solutions which will form the basis for re-engineering the process.

The coloured areas of Figure 22, indicate the steps of the research framework that will be covered in this chapter. The structure of this chapter follows the framework that was proposed in the methodology chapter. Following the Design Research Method, the suggestion step follows immediately after the problem description. It is a creative step where the functionality of the IT artefact is envisioned (Kuechler & Vaishnavi, 2008).

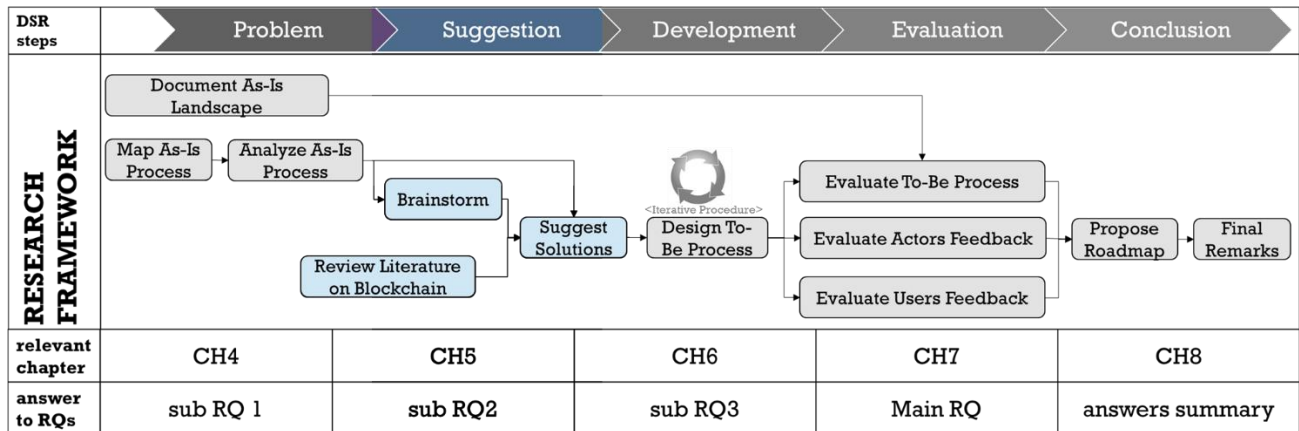


Figure 22: Description of the chapter's framework according to the report's Research Framework as presented in the Methodology

5.1 Matching the blockchain applications with the traditional supply chain flows

As an attempt to differentiate itself from logistics, Supply Chain Management has been defined as the “integrative philosophy **to manage the total flow** of a distribution channel from supplier to the ultimate user (Cooper, Lambert, & Pagh, 1997)”

Supply Chain is the related with the management of three major flows: the physical, information and financial flow (Crandall, Crandall, & Chen, 2014; Hugos, 2011; Sweeney, 2002). The physical flow includes the downstream movement of goods from a supplier to a customer, as well as any customer returns or service needs. The goods (or services) are flowing through value added steps until reaching the buyer. The financial flow consists of money or capital moving upstream from the buyer to supply chain partners that provide services.

The information is moving in both directions of the supply chain and it can involve all amount of required information from and towards the buyer towards partners and the seller. Examples of information flows are invoices, purchase orders, product's analysis reports etc. which are data related to the financial as well as the goods flow. During trading, the flows between the buyer and the seller are shown in Figure 23.

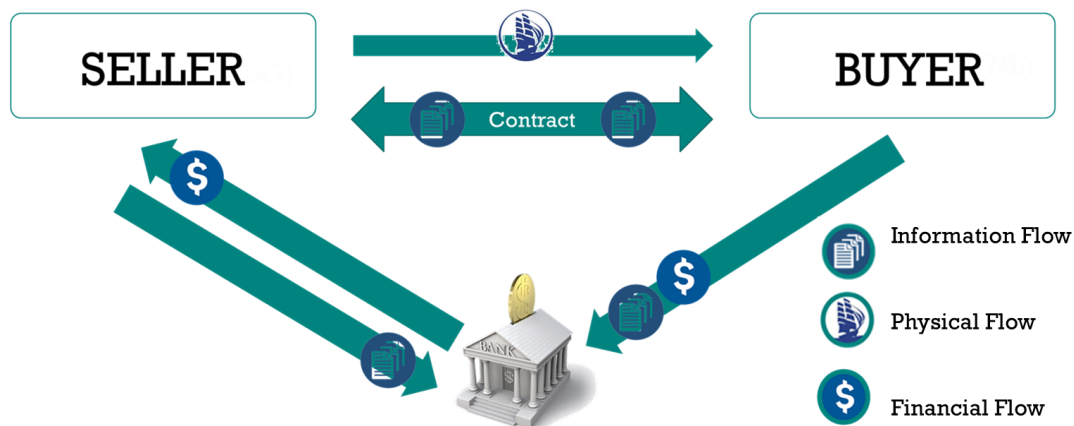


Figure 23: The 3 basic flows of the physical trading business process

In order to match with supply chain management, a literature review on blockchain applications was conducted and all solutions were categorized among the above mentioned major flows. All ideas were structured thematically in 3 synthesis matrixes and the theme of each source was noted. Next to it, some related concepts that were constantly mentioned in those papers, together with some known prototypes were tracked. The **3 synthesis matrixes can be found in Table 8 and Table 9 in the next pages.**

The literature described in the next matrices is not further explained since the intention of this step was to understand the several possibilities that the new technology can give. The findings were created by the author in order to grasp the possible applications of the technology and in the next section, a way of categorizing such application is proposed.

The sources were found by following the same method that was presented in p.20 of Chapter 2 (Literature Review). Associated keywords included “applications of smart contracts”, “applications of blockchain in supply chain”, “trade finance blockchain”, “documents processing blockchain”, “provenance blockchain”. Additionally, documents that were found earlier in Chapter 2 were further scanned and whitepapers of innovator companies were also used in order to track some running prototypes.

Table 8: Synthesis Matrices of Blockchain applications categorized in information flow and physical flow

INFORMATION FLOW	APPLICATIONS FOUND IN LITERATURE					PROTOTYPES	CONCEPTS
	(Hackius & Petersen, 2017)	(Beije & Jullens, 2017)	(Bocek et.al , 2017)	(PwC, 2017)	(Liu et al., 2017)	IBM & Maersk: Digitizing paper-based freight documents (eg. Bill of Lading) (Maersk, 2018)	Workflow management, virtual ecosystem, data transparency, sharing information proactively, cross-chain collaboration, data verification, supply chain digital platform
	Ease of paperwork processing between stakeholders in all trade flows	Cross chain collaboration: virtual ecosystem	Documents verification	Trade Documentation Supply Chain and Logistics Optimization →Asset Tracking, Bill of Lading, Transfer of Title	Data integrity verification without relying on any Third Party Auditor		
PHYSICAL FLOW	APPLICATIONS FOUND IN LITERATURE				PROTOTYPES	CONCEPTS	
	(Hackius & Petersen, 2017)	(Beije & Jullens, 2017)	(Staples, et al., 2017)		IBM & Walmart: Tracking movements of food items (IBM, 2017). Everledger: provenance platform & fraud detection system for items (Everledger, 2018).	Visibility, Transparency, Sustainability, Traceability, Provenance Machine to Machine Communication, IoT & Blockchain enabling transparency	
	Identify Counterfeit products	Better tracking of orders and assets, track and trace of agri chemicals	Supply chain visibility & provenance				
	Facilitate Origin tracking: data related to goods characteristics	Upfront compliance through transparency					
	Operate IoT: goods(objects) exchanging data over the internet						
	(PwC, 2016)	(Tian, 2016)	(Christidis & Devetsikiotis, 2016)		Mattereum: Internet of Agreements project to manage legal rights over physical property (Mattereum, 2017).		
Enabling Machine-To-Machine Communication	supply chain traceability system for food safety based Blockchain & IoT	IoT devices interacting autonomously through smart contracts: proactive sharing of data					

Table 9: Synthesis Matrices of Blockchain applications categorized in financial flow

FINANCIAL FLOW	APPLICATIONS FOUND IN LITERATURE				PROTOTYPES	CONCEPTS
	(PwC, 2017)		(Staples, et al., 2017)	(Christidis & Devetsikiotis, 2016)	IOTA: Platform designed for the Machine to Machine Economy (IOTA, 2018). Slock.it: Enabling renting, selling or sharing property on blockchain by the use of smart contracts (slock.it, 2018).	The economy of things, payments triggered by events, sharing economy
	Financialization of Commodities Today only the front end of commodity trading has been financialized, in the form of electronic trading. With blockchain, the infrastructure could be financialized as well!		Key events within the supply chain could be linked to automatic payments with the use of smart contracts	IoT devices interacting autonomously through smart contracts: payments		
	(PwC, 2016)	(Beije & Jullens, 2017)	(Staples, et al., 2017)	(Omran, Henke, Heines, & Hofmann, 2017)	PROTOTYPES	CONCEPTS
	Trade finance, instant matching and of settlement trades	Post shipment financing, in-transit financing (SCF)	International Payments, Reconciliation for correspondent banking, Securities registration, clearing and settlement, markets, trade finance (Financial Services)	Elimination of existing inefficiencies in the execution of discrete SCF-instruments	Tradecloud: e-procurement and e-commerce platform for manufacturing and wholesale (Tradecloud, 2018). r3: Company leading a consortium which includes the world's biggest banks for the development of blockchain in finance (r3, 2018).	Reverse factoring, Dynamic Discounting, Supply Chain Finance, Trade Finance, Reverse Securitization, Post-trade settlement, Post-trade clearing

5.2 Blockchain applications: Supply Chain Flow & Business Process point of view

In order to localize opportunities in supply chain management, the author proposes to categorize the applications in the three usual supply chain flows, inspired by the literature review where applications were categorized per flow (own work). It is next proposed to enrich it by splitting each application in two sub-categories in order to adapt Weber's (2016) approach (see section 2.2.4) in business process management which is thought to correspond to Swan's (2015) generations 1.0 in the case of choreography monitor and a generation 2.0 in the case of active mediator (see section 2.2.1). The author would visualize the full system including all three supply chain flows as the blockchain generation 3.0.

5.2.1 Applications related to Information Flow - Data Processing

This proposed category is related with **monitoring and coordinating information flows** in a virtual ecosystem. It is referring to registering, sharing, processing or tracking documents (or data sets) as well as related actions that can be programmed to occur upon existence or abundance of specific documents or data points.

The blockchain technology could offer a neutral and immutable space for virtual cross-chain collaboration which would allow participants to exchange information faster and with less frictions (Beije & Jullens, 2017). Furthermore, it could give the ability to trace information back to the source, has proven to have a built-in trust and eventually offer transparency (Iansiti & Lakhani, 2017).

Monitoring information flows

The cross-collaboration between the several actors in the supply chain could be monitored within a blockchain solution where trustable data can be stored (Beije & Jullens, 2017). Those data will be hard to tamper and therefore fraud of original documents such as a Bill of Lading or a Certificate of Origin would be effectively prevented (PwC, 2017). Actors could register in such a platform and the processing of documents in situations that require input from multiple actors could be more efficient since each data point could be entered once in the system while used multiple times by each stakeholder for a different use. One source of truth would be therefore available which would increase transparency as well as efficiency.

Documents or data of importance could be entered either by a trusted party or generated by trusted devices (eg. GPS coordinates of a vessel) where the system runs on trusted workflows (PwC, 2017).

Coordinating information flows

The collaboration of the several parties could be coordinated with the help of smart contracts, where several actions are executed by following the business logic behind each business process (Chamber of Digital Commerce, 2016; Dumas, La Rosa, Mendling, & Reijers, 2018). In this way, data sets or full documents can be created, approved, rejected or even extracted and re-used by several parties (Bocek, Rodrigues, Strasser, & Stiller, 2017; Hackius & Petersen, 2017). In addition, some processes can be triggered automatically as a result of the available data. An example of a self-executed action would be the creation of documents (eg. Bill of Lading once all necessary information is registered in the system or the auto-submission of such documents in the associated actors.

5.2.2 Applications related to Physical Flow - Product Tracking

This proposed category is related with **monitoring and coordinating product flows** in a virtual ecosystem. It is referring to registering, sharing, processing or tracking assets as well as related actions that can be programmed to occur upon existence or abundance of specific data points or goods characteristics.

The blockchain technology could offer transparency of a product's identity, prevent fraud and visibility throughout the supply chain (Bocek, Rodrigues, Strasser, & Stiller, 2017; Staples, et al., 2017). Furthermore, better risk management can be offered while the transfer of the risk will be easier to handle.

Monitoring Product Flows

Storing trustable and immutable data related to the product can contribute in monitoring the goods identity and when combined with IoT data can be verified or traced without the need for a third party auditor (Liu, Yu, Chen, Xu, & Zhu, 2017; Tian, 2016). Counterfeit products and fraud can be prevented where information regarding the good's provenance can be traced (Everledger, 2018; Staples, et al., 2017). In this way, best practices can even be enforced in industries.

Coordinating Product Flows

The physical flows and associated information could be coordinated through blockchain where actions can be triggered as a result of a product's specifications. Product's analysis results, titles of ownership or proof of its uniqueness can be registered in the system. For instance, a product's lab analysis can automate a payment upon quality, titles of ownership can be transferred real time while disproving a product's uniqueness could automatically reject an agreement (eg. counterfeit valuable products) (Beije & Jullens, 2017; Bocek, Rodrigues, Strasser, & Stiller, 2017; Everledger,

2018). This would make several processes such as incident management, insurance claims, dispute resolution or arbitration more efficient (Deloitte, 2017; Hogan Lovells, 2017; Pinsent Masons LLP, 2017).

The application of IoT with Blockchain has a high potential in monitoring and coordinating physical flows (Liu, Yu, Chen, Xu, & Zhu, 2017; Tian, 2016) but the several challenges related with the security and privacy of IoT together with scalability and latency of blockchain need to be addressed first before their combination becomes a viable solution (Dorri, Kanhere, Jurdak, & Gauravaram, 2017; Khan & Salah, 2018).

5.2.3 Applications related to Financial Flow - Trade Finance

This category is related with **monitoring and coordinating financial flows** in a virtual ecosystem. It is referring to registering, sharing, processing or tracking financial transactions as well as related actions that can be programmed to occur upon existence or abundance of specific data points or financial results.

The blockchain technology could offer faster payments since financial audits can be accelerated once all information is in one trusted system. This will mean that less actors will be required for auditing the process, less fees from speed payments will be required, while processing fees can decrease. In addition, the system's transparency would give the opportunity to finance not only the front-end of commodities but also the infrastructure. Furthermore, direct visibility of ownership changes can be seen when required (Staples, et al., 2017).

Monitoring Financial Flows

Stakeholders required for executing a payment can interact and exchange information in one ecosystem where actors or the system itself can verify invoices or requirements met for execution. Tracing a payment, related information or tracking a full financial flow across the supply chain is enabled. Furthermore, financial activities such as issuing invoices can now occur in one system which comes with reduced transaction costs can be made possible.

Coordinating Financial Flows

Several financial related activities could be triggered by blockchain. For instance, payments could be executed automatically if the business rules followed are standardized and coded in a smart contract. The functionality could be further enhanced in combination with IoT devices where the system could for instance execute a payment once a GPS tracker confirms the arrival of a shipment. Therefore, instant matching and settlement of trades could be realized. Additionally, the

execution of discrete supply chain finance instruments such as reverse factoring, dynamic discounting, post shipment financing or in-transit financing could be made possible (Beije & Jullens, 2017; Omran, Henke, Heines, & Hofmann, 2017; Staples, et al., 2017) where the supply chain's front end as well as the infrastructure can be financialized (PwC, 2016).

Efficiently extracting trustable data direct from the source would be possible and could be used to make predictions and identify market patterns, transfer risk or build reputation in a system could be accomplished.

5.3 Suggestions from the brainstorming session

The full business process was mapped and presented in Chapter 4 and a flowchart together with a brief description of the process is available. This exact input was used during a multi-stakeholder brainstorming session as an attempt to reflect on the process and propose solutions that would tackle the perceived bottlenecks.

The participants were mostly actors from the described process while two senior supply chain experts from the organization together with an external logistics consultant with experience in blockchain technology, joined the session as well. The participants were then split in 3 teams while the three experts were split among those groups. Stakeholders had the opportunity to reflect on the involved tasks, locate bottlenecks and propose ideas for improvement during the session.

A detailed list of the participants and a debriefing of the workshop can be found in Appendix 6 and 9 respectively. For more information regarding the method please refer to section 3.5.1. At this section only a summary of the brainstorming session, together with the identified themes will be presented.

In total, 9 solutions were proposed, covering the whole spectrum of the process. The discussed solutions were then categorized by the author in four themes:

- A. proactive information delivery throughout the ecosystem
- B. entering data that need approval by other parties
- C. physical or information flow triggering financial transactions
- D. optimization of the physical quality assurance process (out of scope for redesign but suggestions will be made)

The actor's proposals were translated to the solution themes that were named in the previous section. This input was used in drawing a **Critical to Quality (CTQ) tree** aiming to derive

specific requirements from general needs and capture the voice of the customer (Basu, 2014). CTQ trees are common measurements in the Six Sigma process improvement method and is widely used as a way to consider the actor's requirements and expectations before the re-design (Thomsett, 2005).

Based on the brainstorming input, the first three themes were translated by the author to needs whereupon the drivers behind the needs were considered. Those drivers were next converted into Critical to Quality (CTQ) requirements. The CTQ tree is presented in Figure 24.

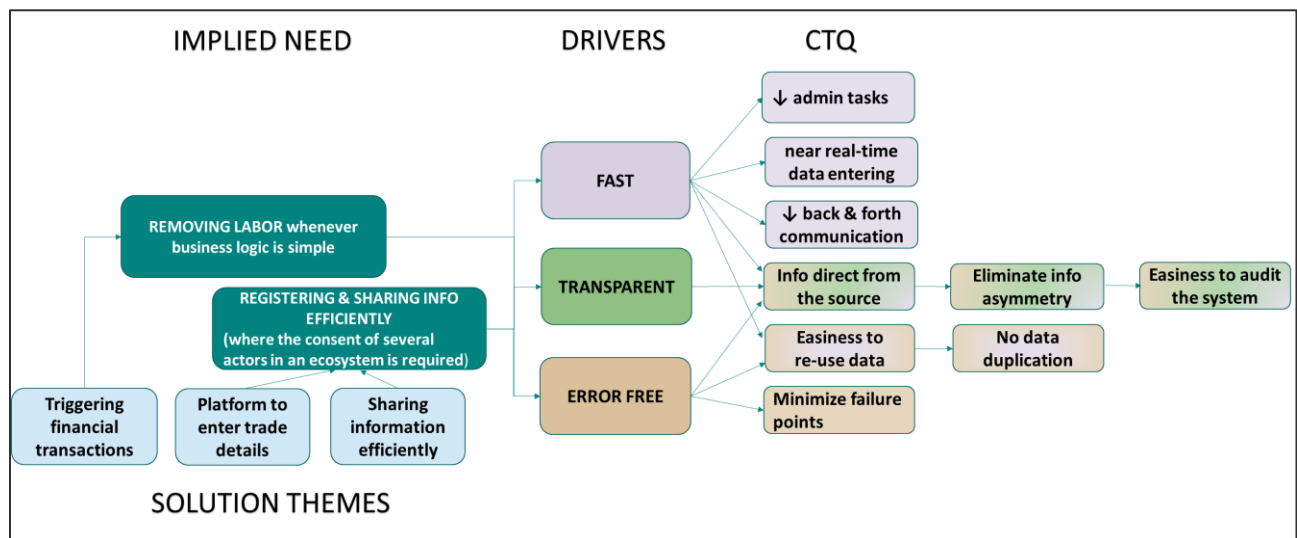


Figure 24: Critical to Quality tree for capturing customer requirements of the process

5.4 Suggested changes of the business process

Taking into consideration the brainstorming suggestions and the functionality enabled by blockchain technology, changes to the process are suggested. A summary of those changes is described in Table 10.

Table 10: Summary of suggested changes

	Suggested Change	Blockchain functionality	Expected Benefit
1. Trade Agreement	Contracts to be entered in a blockchain platform by trader	monitoring & coordinating information flows	transparency, one source of truth, no double entries + no handovers = efficiency & less errors (CTQs)
2. Loading	Sharing and processing documents in blockchain	monitoring & coordinating information flows	
	Washout in Blockchain where buyer & seller are interacting	coordinating information flow that can trigger a financial settlement (financial flow)	
3. Contract Execution	Tender automatically triggering actions (notify surveyor, autorefill in ERP)	coordinating information flow	
	Information related to physical shipment to be available in blockchain	monitoring information flows	
	Automatic payment triggered upon vessel arrival	coordinating financial flows (smart contracts & trade finance functionality)	
	Automatic payment triggered after 45 days of the B/L date	coordinating financial flows (smart contracts & trade finance functionality)	
5. Finalization	Automatic payment triggered upon surveyor's analysis results	coordinating financial flows (smart contracts & trade finance functionality)	

5.4.1 Suggestions for the Trade Agreement step

The trade agreement is the first point of data entry in the process and its function is to register a trade that has occurred. In the as-is process it was noticed that back-and-forth communication was required in order to align with the deal that the traders had made. In order to **reduce waste from handover of tasks, it was thought to eliminate all actors and hold the trader responsible for entering a trade in the system.**

In addition, an extra actor was cross-checking the input and matching several documents which was seen as the most time-consuming part of the process. In order to **eliminate this control point it was considered to move the trust into a blockchain platform** which is also a customer requirement. The information that would be entered in the system would be immutable and auditable in case of mistakes while there would be only one source of truth and therefore cross-checking several documents would not be required since there would not be multiple entries at first place!

5.4.2 Suggestions for the Loading (administration tasks) step

The physical process was considered out of scope and only some general suggestions were made. The focus was again on the buyer and the seller while the data elements from external actors were also considered. The brainstorming and time estimations showed that the same data was shared multiple times with the stakeholders and inserted in several information systems. In order to **avoid handovers via e-mail and eliminate information asymmetry, all important actions and information was thought to be shared in a blockchain platform.**

All steps that need to be audited from both the actor's trade execution as well as the seller's trade execution desk were included in the process. Blockchain was thought **to monitor and coordinate the information flow of this step.**

Inspired by the trade agreement re-engineered process, it was thought that a washout can also be designed as an agreement that has to be agreed upon. This **would again reduce waste from handover tasks and would use blockchain for monitoring trades, agreeing upon washouts and triggering the execution of washouts in ERP systems.**

5.4.3 Suggestions for the Trade Execution step

According to the FOSFA 80 contract (Contract for Crude Unbleached Palm Oil in Bulk CIF Delivered Weights, 2008), as soon as the tender is created, the shipment is considered officially declared and information regarding the ship's name, date of the Bill of Lading(s), description of the commodity type and an approximation of the weight to be shipped to the seller is acknowledged. This means that the commodity is pending physical delivery which cannot be washed out anymore. In all, the tender is a notification informing the buyer that the commodity that was bought is about to be delivered. The tender is a data set which is created from the shipper and it is a starting point to start executing a contract. Information should be shared with both the buyer and the seller so the contract execution step can start. The unloading surveyor should also be informed about it so that the surveying procedure can be planned ahead.

Since all parties need to have access, it was thought to have such a document in a shared platform. Blockchain as a technology would offer the immutability of the stored data while in case of dispute (eg. disagreement on load surveyor reported volumes and tender details) the smart contracts functionality would help to solve the disagreement. **The information flow regarding the physical shipment can therefore be monitored** through this platform and the next actions that need to be taken in the ecosystem can be coordinated.

The provisional payment needs to be paid on a specific time frame: either upon arrival or 45 days upon the Bill of Lading's date. The **smart contract functionality of blockchain can trigger a financial transaction which will be programmed in accordance with the predefined contract rules.**

5.4.4 Suggestions for the Loading & Unloading step (physical activities)

Loading and unloading steps are mostly driven by physical processes while only a few administrative tasks are taking place. Regarding the physical processes, a new design has not been prepared since this part is considered to be out of scope for this research as most of the actors were out of the predefined unit of analysis. Hence, the actual loading and unloading steps have not been mapped in depth and it would be advised to further map the physical processes so they can be properly analysed. **The information flowing from those processes are however important, since payment is executed upon the product's quality.** This information is taken into consideration in the next step.

Modernizing the surveying process would be necessary where analytical methods, tools, procedures and data sharing could be optimized or revisited so that the process can fit to the upcoming industrial revolution. One idea would be for instance to collect less pre-shipment or loading samples and enhance results with predictive analytics tools.

Exploring the possibility to have more sensors and online analysis in the vessel could also be investigated further. Transporting the samples to the lab faster and cutting the extra courier costs (eg. by a pneumatic tube transport system or drones) would be another suggestion that could be scrutinized. Furthermore, analysis instruments that can support direct reporting and production of certificates could also be considered.

In order to re-design the above mentioned processes, involved actors such as surveyors, unloading coordinators and lab technicians should provide insights on the related processes. It would be expected that incremental changes and a more traditional approach such as TQM or Six Sigma would fit better for this matter. Participation of FOSFA regulators would be crucial, since revision of those processes could set the standard for the whole market.

5.4.5 Suggestions for the Finalization step

All important information that determine the final payment are included in the surveying report that is issued during unloading. Hence, as soon as **data from the surveying report are entered in the blockchain platform, the payment can be triggered.**

CHAPTER 6: DEVELOPMENT of a new Business Process

In the previous chapter, the as-is process together with the blockchain technology were examined. The emphasis of the new re-design is put on **administration tasks and associated interactions between the buyer and the seller** whereas the input given from actors of the rest of the swim-lanes is assumed to be contributing as data elements that is providing sufficient information for the process to be executed. In addition, the focus of the redesign was on tasks that are standardized and follow business logic so that their further automation is most probable.

Following the DSR method and the framework that was presented in Chapter 3, the iterative steps that led to the discovery of the artefact design are described (Gregor & Henver, 2013). The coloured areas of Figure 25, indicate the step of the research framework that will be covered in this chapter.

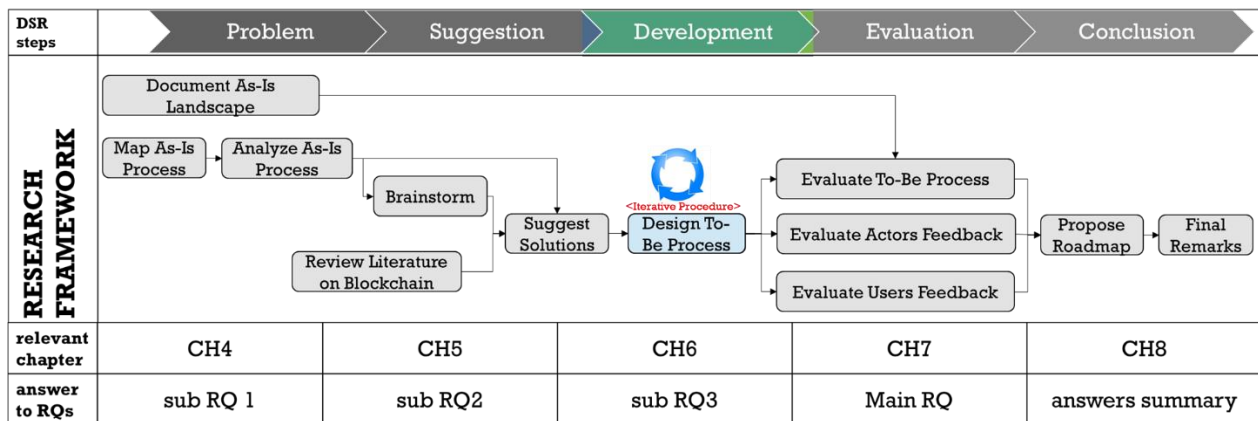


Figure 25: Description of the chapter's framework according to the report's Research Framework as presented in the Methodology

In order to re-design the process a Business Process Management approach will be adopted which includes principles from Total Quality Management and Business Process Reengineering while it mitigates the limitations of both approaches (Hammer, 2010).

TQM approach which is also popular approach for designing a to-be process, focuses on task standardization and it is more suitable in optimizing manufacturing procedures and it contributes in minor changes (Butler , 1994). Since it has a task oriented nature it can be argued that it discourages creativity and innovation. In this report, a new radical foundational technology is introduced (Iansiti & Lakhani, 2017) which can be supported better by a Business Process Reengineering approach where changes are major. However, BPR methods are criticized for encountering the resistance to change as an obstacle (Marjanovic, 2000) and it is highlighted that

most prominent innovations are enabled by the combination of IT, information and people (Davenport, 1993).

In order to mitigate limitations from both approaches, a Business Process Management approach is therefore adopted, which offers a holistic view of the case and includes people, processes, technology and strategy (Hammer, 2010). Rethinking the process in a cross functional way (Fagan, 2006) is what will increase the possibility of success.

6.1 New Process Description

The identified non-value adding tasks and time estimates for executing those activities that was found in chapter 4, contributed in prioritizing what to redesign in each sub-process. The three solution themes that were extrapolated from the brainstorming results (*A: Proactive information delivery throughout the ecosystem, B: Entering data that need approval by other parties, C: Physical or information flow triggering financial transactions*) were considered. In addition, the categorization of blockchain applications that was proposed earlier was used as a reminder that blockchain can smoothen each flow by either monitoring or coordinating it whenever possible.

Inspired by Hammer, a new business process was created, which aimed to “obliterate” (Hammer, 1990) the current process and re-invent a new one that can create breakthrough performance gains. The focus was on the process and to what needs to be achieved in each step rather than what was included in the previous flowchart. Old traditions and rules such as an actor’s roles or the trust element provider were broken while the use of new IT methods was adopted. Those four principles were introduced by Hammer and Champy (1993) in the past and were followed during the re-design.

An agile approach was adopted where the researcher created a first design. This design was next discussed with a continuous improvement expert and with at least one actor representing the process step that is revised. Hence, there are two iterative steps that resulted in the new design. The description of the new designs and the ideas behind them are presented in the next section. All designed flowcharts can be found in Appendix 2.

6.1.1 Process Description: Trade Agreement

The process starts with communication between parties where an agreement for a trade of a specific product is initiated. Either of the two traders can capture and register that trade in a common shared interactive database. The counter trader will then be asked to verify that this

trade occurred and that the registered information is correct. In case of a dispute, any of the traders can proceed to corrections and once both of them verify, then the trade agreement is official.

This process is depicted in the Appendix 2. A trader receives a push notification each time an action is required from her side. In addition, the trade details are entered in each party's ERP system.

6.1.2 Process Description: Call Order & Vessel Nomination (administration tasks)

The process starts with the evaluation of oil demand by the buyer's trading team. There is a constant communication between seller's and buyer's traders regarding the contracts that are already agreed upon, with respect to their quantity and period of shipping. The quantity and period of product shipment is registered in the common shared platform by the buyer's trader. Then the buyer's trader determines whether a physical shipment is necessary. In case there is no need for physical trading a washout with the seller is arranged and then the seller arranges a washout with its suppliers. The washout step is explained in next section.

Cargill's Transportation team will check whether shipment capacity and dates and inform the seller whether a shipment is possible. In case there is no fit, the request can be rejected and an advice can be offered from the transportation team to the traders. As soon as the shipment and capacity fits, OT can enter shipment details in the platform. The contract execution department can then take over where both sides will check and acknowledge the associated registered contracts in the application. Once they both agree, the contracts can be automatically split in parcels of 250 tons each, which is a standard parcel of the palm oil market and B/Ls for each parcel can be issued. Contract details can then be inserted in both party's ERP system.

6.1.3 Process Description: Washout (administration tasks)

A washout has been re-designed as a standalone process which can occur anytime as far as both trades and countertrades have occurred. The process starts with any of the two parties' trade execution desk, where a representative selects to wash out a trade inside the common shared platform. The counterparty's trade execution representative can either approve or amend the trade. Once they come to an agreement, the washout can be executed in that platform while information should be extracted and entered in each sides' ERP system. The finance should next be informed about the taken action so a settlement can be arranged.

6.1.4 Process Description: Trade Execution

After loading, a tender is created by the shipper and uploaded on a common shared interactive database. This database can verify whether the information shared by the surveyor match the information included in the tender document. At this stage, the unloading surveyor can be automatically notified about the expected volumes and estimated time of arrival of the vessel, information that can be extracted from the database. The buyer's trade execution desk will be notified as soon as the tender is available and will attach it to the contract. Next, both the seller's and buyer's trade execution desk will need to create in their ERP systems, a purchase and sales order respectively. Based on those orders, an invoice will be attached to the contract in the common database which will be seen as a pending payment from the buyer to the seller.

All necessary original documents can be either uploaded in the platform or even automatically generated by using the related information that are already available in the system. The seller can check the documents as soon as they are created and approve them. In case of a FOB contract, the payment can be automatically triggered as soon as the documents are approved.

The surveyor will be responsible to register the time of arrival of the vessel and enter such details in the platform. In case of a FOSFA 80(CIF Rotterdam), the documents need to be approved and next a payment can be programmed to be executed 45 days after the Bill of Lading date or upon vessel's arrival, depending which of the two come first. Any of the two actions can be triggered from information available in the system.

6.1.5 Process Description: Finalization

After unloading, the surveyor is responsible to upload the results of the analysis. Both parties can then be notified and check the uploaded documents. If there is no objection regarding the reported analysis results, both parties can enter the details in their ERP systems and create invoices.

Depending on the rules stipulated on the contract, the business rules can be standardized where the final settlement price and timing for payment can be defined. For the FOSFA 80 contract it would be determined whether the buyer or the seller needs to make a payment depending on the product's quality and it has to be paid in not more than 21 days since the issuing of the final invoice.

6.2 Corrections based on actor's feedback (3rd iteration)

The previous input and produced flowcharts was discussed with the team in an open discussion. During the feedback session, concerns were raised, some corrective steps were performed and the final re-engineered process emerged.

6.2.1 Trade Agreement

Feedback 1: The first design proposed by the author implied that any of the two actors would be possible to enter the trade. However, during the feedback session, the trader mentioned that the person held responsible to enter the agreed trade should be communicated upfront, otherwise it would be a risk that no one would enter the trade.

Changed design? Yes. The seller was considered responsible for entering the trade. This does not seem to hold a risk, since there has been already a pre-agreement through a phone communication. According to FOSFA contracts, an oral agreement is still legally binding and therefore a buyer would not be expected to be able to skip registering a trade.

Feedback 2: The possibility of automating the approval step on smart contracts was also discussed. The idea was to have a pre-defined price limit, whereupon trades are accepted automatically. This was however considered a risky step and it was mentioned that the price would have to be constantly adjusted.

Changed design? No. Due to the doubts from the actors it was decided not to increase complexity further.

6.2.2 Call Order, Contract Averaging & Vessel Nomination

Feedback 3: The actors mentioned that the contract averaging occurs in order to have the fewest possible contracts to enter in the ERP system. Furthermore, is a procedure that does not always happen when there is a trade with other actors. If

Changed design? Yes. Assuming that the design would need to be fully integrated with an ERP system, the agreed contracts can be fed directly in the ERP. Therefore no contract averaging would be required for reducing manual work, since this input will have to be inserted automatically.

6.2.3 Contract Execution

Feedback 4: The possibility of automating the attachment of the tender to the contract was confirmed the actors. It was thought that it could follow the same rule that is stipulated in the FOSFA contract which mentions that deviations between the requested volume and the actual loaded volume can deviate maximum 5%. In case of a deviation of greater than 5% (which uncommon), the buyer can negotiate for new terms and request a contract amendment or default.

Changed design? Yes.

6.2.4 Loading & Unloading Quality Assurance Suggestions

Feedback 5: It was mentioned that in reality, the oil to be delivered is sometimes comingled and the quality in each compartment where oil is stored might vary. Samples are taken from each compartment and quality has to be met in each of them in order to be accepted. Multiple compartments might be named under one Bill of Lading but what matters at the end (given that each compartment's quality is ok) is whether the quality meets the contract's rules.

Changed design? Yes. The final payment will be guided by the surveyor's report, however for the product to be accepted, the quality must satisfy the FOSFA rules in each compartment as well.

6.2.4 Loading & Unloading Quality Assurance Suggestions

Feedback 6: It was mentioned that in reality, the oil to be delivered is sometimes comingled and the quality in each compartment where oil is stored might vary. Samples are taken from each compartment and quality has to be met in each of them in order to be accepted. Multiple compartments might be named under one Bill of Lading but what matters at the end (given that each compartment's quality is ok) is whether the quality meets the contract's rules.

Changed design? Yes.

6.3 Final Proposed To-Be Design Discussion

During the feedback session, some of the feedback was incorporated in the design. Those changes are described in the previous section while the rest of the process remained unchanged. In the next page, **Figure 26 shows the finalization step as an example of a re-designed process.**

All final business process flowcharts can be found in Appendix 3. In the forthcoming chapter, the new business process will be evaluated.

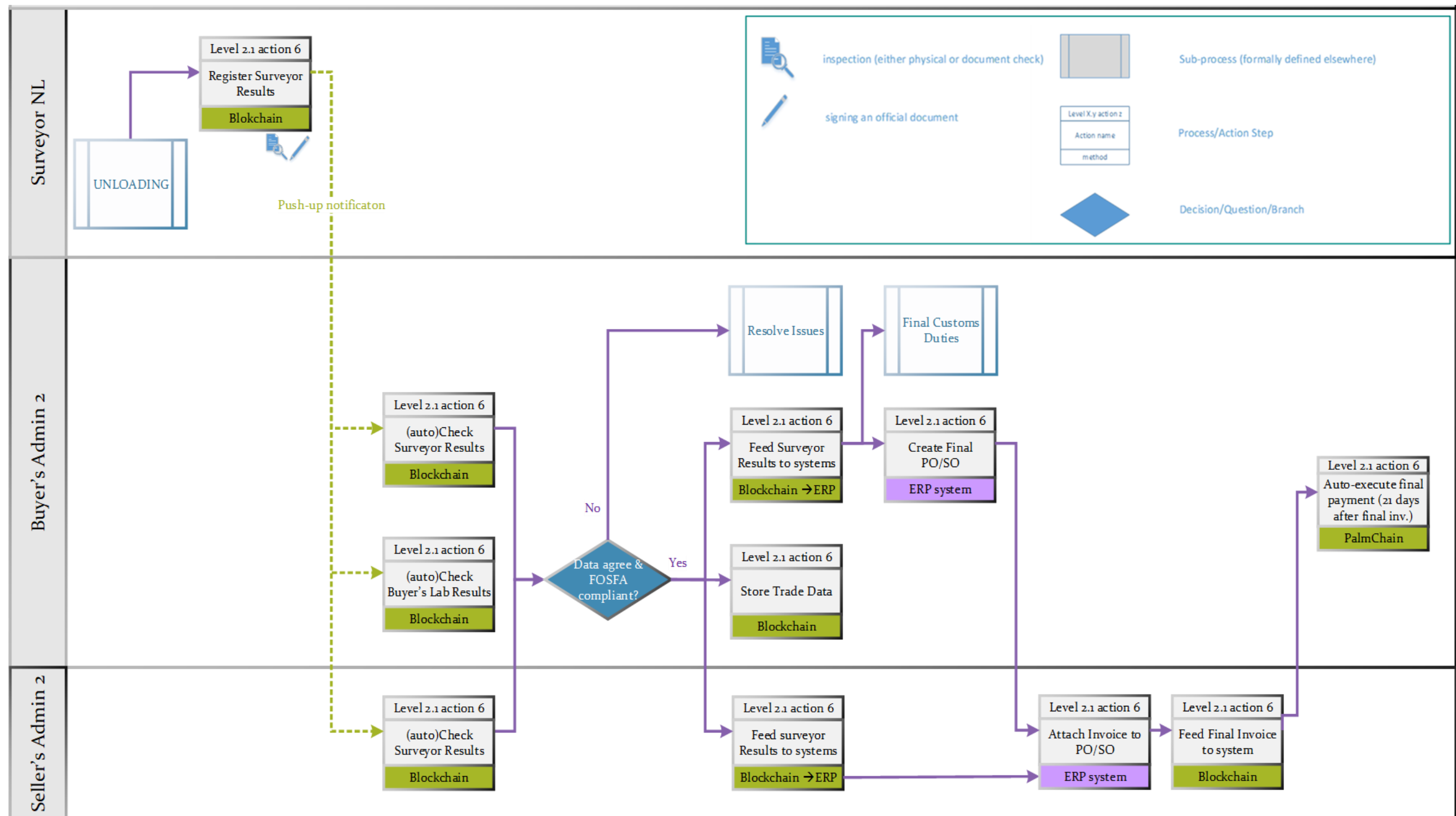


Figure 26: Redesign of the Finalization Business Process (public version)

CHAPTER 7: EVALUATION of the new Business Process

In this chapter, the new business process will be evaluated against the organization's current process. Furthermore, the industry's suitability will be assessed and concerns raised from experts will be presented. Hence, a multidimensional approach for the evaluation was chosen. This step is in accordance with the DSR approach described in Chapter 3 and the Evaluation phase can be seen in the picture bellow. This chapter will provide evidence that the new design is useful so that the "proof-of-concept" is motivated (Gregor & Henvner, 2013). The coloured areas of Figure 27, indicate the steps of the research framework that will be covered in this chapter.

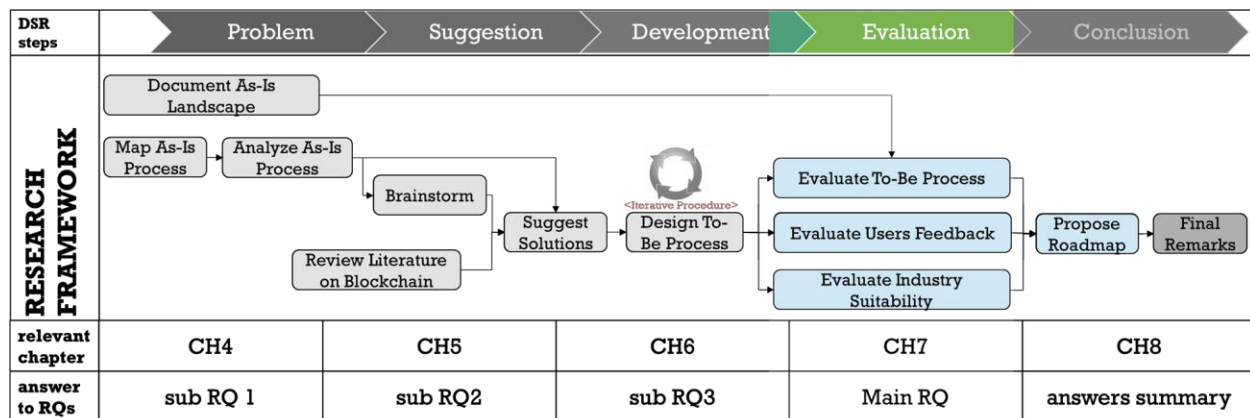


Figure 27: Description of the chapter's framework according to the report's Research Framework as presented in the Methodology

7.1 Evaluation of the To-Be Process

The inter-organization activities between the buyer and the seller of the crude palm oil trading business process were redesigned in the previous chapter, by leveraging the opportunities offered by blockchain technology. The most radical change was the trade agreement step which is the first point of data entrance and throughout the process the data are enriched. A **new information system** where all contracts are captured and are auditable by both parties was suggested.

Furthermore, the duty of verifying the agreed futures contracts was now on the traders instead of the contract execution parties which implied **an organizational and cultural change**. Regarding the other phases, the benefits lie in the fact that information are directly extrapolated from the previous steps and information of common interest are available for all parties in one system.

In order to quantify the benefits, the time savings for each phase were estimated during a discussion with the stakeholders. Actor's involved with the process were provided with a

description of the new business process and a brief description of each step. They were then asked to quantify the time that would be required to complete certain tasks. This input was compared with the actor's estimation of the as-is process that was presented earlier in Chapter 4 (section 4.3.2)

The new Trade Agreement step seemed to be 85% more efficient than the current one. Here, the input is entered and approved by traders while the tasks from the other 4 actors become obsolete. Additionally, entering information in the ERP system is not required since structured data from the blockchain are fed back in the system. However, in case the solution is not fully integrated with ERP, the new step becomes more inefficient since double entry of information and reconciliation between systems will be needed. The risks of copying wrong data between different platform is also removed since a blockchain database could be the source of truth for all actors and data can then be fed in each actor's (ERP) systems. Even when adopting only this step of the full mapped business process, a 45% time savings in administration is expected to occur.

As mentioned in Chapter 5 and 6, during Loading, the contract averaging activity is not needed anymore and split of Bills of Lading can be executed automatically according to the market rules (each Bill of Lading included parcels of 250 tons what follows market rules) while the actions related to washout will be coordinated and monitored by blockchain. The role of ERP integration is also vital here, where the effort required doubles in case links with ERP do not exist.

In Contract Execution, most of the data are provided either from the seller or from the shipper and information can automatically checked and fed in the ERP system. Once all required documents (or data elements) are available, an automatic payment can be executed. This means that the buyer does not need to perform any actions anymore except for checking information that deviates from the ones that is stated in the agreed contract. Next, in Finalization step, the results from the product's quality assurance can be automatically checked and trigger a payment which also reduces the required tasks tremendously.

It should be underlined however, that the **new functionalities enabled by blockchain will only be feasible if interoperability among systems exists and ERP systems are fully integrated**. A summary of those results can be seen in Figure 28 while the savings for the seller are available in Appendix 10.b. The full analysis can be seen in Appendix 10. As explained earlier, Step 4 involved physical processes and was considered out of scope of this research. Hence, Figure 28 depicts the savings for steps 1,2,3 and 5.

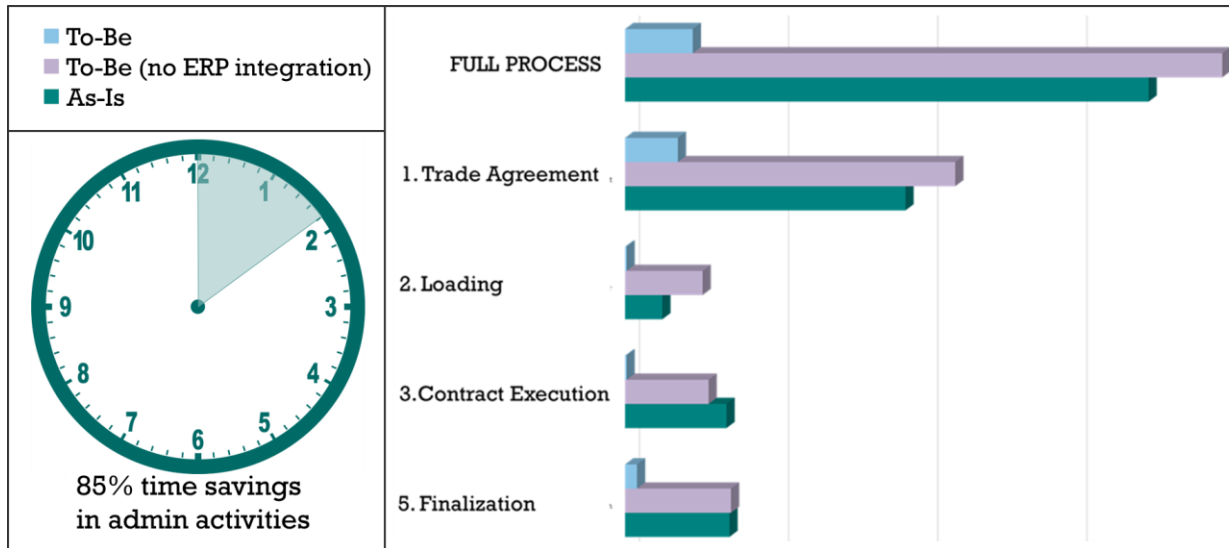


Figure 28: Buyer's Time Saving on Administration Tasks

In Chapter 4, KPIs related to cost, time and quality were proposed for measuring the business process' performance. Here, the **KPIs that are expected to be affected by the new process** will be discussed. In the new design, most changes are related with interactions between the buyer and the seller. Costs related to other parties such as surveyor, lab related costs, shipping or customs are not expected to be affected. In addition, the original documents are proposed to be sent digitally and therefore the cost related to shipping original documents would be eliminated. Bank costs would also be reduced; on the one hand documents that were once collected by banks will now be stored on a blockchain supported platform while on the other hand, speed payments will not be required since actions required for the payment (eg. checking documents) can now be faster. Regarding the time, it was explained earlier in this section that the buyer and the seller are expected to have 85% and 70% savings in time respectively. The lead time would also be reduced since the buyer would not need to wait for the arrival of original documents while the seller's payment would also be faster.

Quality of the administration tasks would also be improved. The number of administration errors would be reduced since both parties can audit the entries. The payment can be triggered automatically once the rules of the signed (usually FOSFA 80) contract are met and the payment can be always executed in time. In addition, all data will be available in one source and missing documents or data points can be automatically detected. In the next page, Table 11 shows the KPIs that were proposed in Chapter 4 for measuring the process' performance is shown where the aforementioned dimensions that are expected to be affected are marked in red colour.

Table 11: KPI's expected to change by the new business process

	PROCESS STEP				
PERFORMANCE	1 Trade Agreement	2 Loading	3 Contr. Execution	4 Unloading	5 Finalization
A. COST					
surveyor		✓		✓	
external lab & technicians		✓		✓	
internal lab & technicians				✓	
shipping & crew		✓	✓	✓	
customs				✓	✓
ocean transportation		✓			
demurrage				✓	
bank			✓		✓
shipping docs			✓		
B. TIME					
buyer's labour force	✓	✓	✓	✓	✓
seller's labour force	✓	✓	✓	✓	✓
lead Time		✓	✓	✓	
port activities		✓		✓	
goods shipping		✓	✓		
C. QUALITY					
# of admin errors	✓	✓	✓	✓	✓
% pay in time			✓		✓
# missing docs/info	✓	✓	✓	✓	✓
# of data sources	✓	✓	✓	✓	✓

7.2 Evaluation through User's Feedback

In general, the several benefits such as automation of business logic, transparency, time savings reduction of mistakes and reduction of paper documents were universally recognized from the experts. The several concerns and prerequisites for success that were discussed are presented in this section.

From a **trader's perspective flexibility and speed of entering transactions** are the most important aspects of such a platform. It was mentioned that in case registering the trade is an laborious process, the trading assistants would be handed in with the task. In order to make it a standardized and fast step, the use of standard templates was proposed. Traders could easily fill in basic details of the trade such as the product (eg. Crude palm oil), the product's certification (eg. RSPO certification), country of origin or the FOSFA contract at which the deal is made upon. Furthermore, it was mentioned that the platform should offer a degree of flexibility while correcting or adjusting input should be made possible.

Experts in trade execution mentioned the importance of flexibility (supporting traders view) in such a system. For instance, currently there are contracts where destination can be one of six different ports and that the platform should have the possibility of editing input in such cases.

Furthermore, the importance of **interoperability of the solution with ERP systems** was underlined in several occasions and was further supported by the time savings estimates in the previous section. In the proposed business process, several data will have to be entered in a blockchain platform. Those data should be automatically extracted and pushed to an ERP system, otherwise the actors will have to enter manually this information which will be again inefficient (see section 7.1). Additionally, an ERP system has the functionality of creating invoices and such information should be able to be communicated back in the blockchain system.

Last, it was recognized that many exceptions exist were actions deviate from the standardized way while there are others that could potentially be fully automated. It was however suggested to test a simple case and use standardized rules as a starting point.

Eventually, in order to realize all benefits the **full ecosystem would be required to join** in such a collaboration platform. Such a solution should therefore be open to both partners and competitors and stakeholders should be willing to participate

7.3 Evaluation of Blockchain's Suitability in the chosen Industry (Business Process)

It is mentioned that the majority of blockchain projects that are currently ongoing do not need blockchain and that such use cases would be more successful when traditional solutions are considered (Gartner, 2017). Therefore, the suitability of blockchain in the chosen business process should be assessed.

In this section, the suitability of the chosen use case will be evaluated and the perceived benefits as described by blockchain subject matter experts during the workshops will be presented.

In section 2.2.3, blockchain was compared with traditional databases. A new process supported by blockchain could detect and prevent potential conflict and enhance reaching consensus across the network (Peters & Panayi, 2015) Another functionality that could only be supported by blockchain databases is the creation of smart contracts (see section 2.2) where parts of software code can be executed within the network whereupon a neutral platform can be offered.

Regarding whether the integration of blockchain is suitable in the reported business process additional sources were considered. Due to the fact that the found sources were not academic literature, subject matter experts were also asked to comment on the expected benefits and suitability of the chosen process. Some prerequisites when considering the integration of blockchain in a solution that were verified include:

- a) the **need to store data** (IBM, 2017; Wüst & Gervais, 2017) where **information is spread across multiple entities** (Auctus, 2017) and hence **multiple parties** are required to participate (IBM, 2017; Wüst & Gervais, 2017).

This was evaluated during the mapping and analysis of the palm oil trading process which showed that information was shared between the process' participants either via e-mail communication or via physical documents across the globe.

- b) The **existence of contractual multiparty relationships** (Deloitte, 2016; IBM, 2017) where contract terms are **standardized** (Auctus, 2017).

Here the parties are interdependent and each actor (surveyor, bank, buyer, seller, shipper) is performing a different part of the process. The contract terms that are used are the ones stipulated in the relevant standardized FOSFA contract.

- c) The need for **data transparency and immutability of data** (Auctus, 2017).

The data transparency and immutability is indeed crucial since it affects several transactions such as the acceptance or rejection of the product, the date of the payment while the amount of the payment is also affected by the data entered regarding the product's quality.

- d) The **existence of interdependent transactions where workflows are complex and manual** (Deloitte, 2017).

During the analysis, it was verified that the majority of administration processes are executed manually where multiple specialists are executing complex interdependent tasks.

Blockchain experts evaluated that in this design events follow each other and blockchain contributed in reaching consensus over transactions. It was argued that the “**the real power is automated business logic**”. In case the actors can trust the system, automating the execution of activities can be realized given that all required data are available in such system. Additionally, if actors can trust smart contracts, then knowing the identity of the counterparty will not be necessary. Furthermore, **maintenance and governance issues** would be expected to arise. Subject matter experts mentioned that a shared immutable blockchain database related to this business process could offer **robustness and resilience** and can **improve process synchronization** by providing real time access to data. If the described redesign is implemented with the help of smart contracts it could furthermore serve as a **neutral infrastructure layer** where the **total cost of ownership can be decreased** as long as the standards development and technical solutions are separated and be taken care of by different parties.

7.4 Proposed next steps for Implementation

The technology is still not fully developed and several technical issues need to be solved such as scalability, latency, privacy and security (Morabito, 2017; Swan, 2015; Yli-Huumo, Ko, Choi, Park, & Smolander, 2016; Zheng, Xie, & Dai, 2017). Practical matters such as regulations, governance and maintenance of systems should be carefully considered and agreed upfront between the involved parties while awareness should be raised so that the capabilities of blockchain can be widely understood besides its complexity (Morabito, 2017).

It is further underlined that the success of blockchain relies 80% on business process change and 20% on technology implementation (Mougayar, 2016). Sustained management commitment, leadership and setting a realistic scope and resistance to change are all factors required for an effective implementation (Doherty & Misty, 1996).

The probability of success for a business process change is increased when processes are thought cross-functionally (Fagan, 2006) where social and organizational challenges need to be considered (Horton & Wood-Harper, 2006) and actor's resistance to change can be minimized. The thesis showed further that interoperability among systems and participation of the full supply chain ecosystem would be necessary in order to realize the found benefits.

Taken into consideration the technical and the practical challenges, a proposal for adoption is crafted in this section. First, the choice of adopting blockchain and whether the organization should be an early adapter will be motivated. Next, in the forthcoming two sections, a long term roadmap for adoption and short term actions that need to be realized will be provided.

Cargill as an Early Adopter or Not?

As explained in the literature review, blockchain is considered to be a transformation technology that reinvents the ways business is done across industries and therefore it will be expected to affect industry dynamics and operating models (Gartner, 2017; Iansiti & Lakhani, 2017). It is expected that 5-10 years will be required until it will be ready for mainstream adoption.

Cargill should decide whether to adopt a blockchain enabled business process such as the one that is proposed in this report and further decide when and how to proceed. Regarding the timing of the adoption, Roger's (2003) popular innovation adoption curve shows five types of adopters of innovation (see Figure 29 in the next page):

- a) **innovators** who have resources to innovate and are prompt to take a risk,

- b) **early adopters** who are opinion leaders, open to new ideas while their stance signals confidence to sceptical parties for adopting the innovation,
- c) **early majority** who are thoughtful groups but are still able to accept change faster than others,
- d) **late majority** who are sceptic and will use new ideas only when it is fully proven by the previous adopters and the
- e) **laggards** who are considered traditional, are critical to new ideas and will only accept innovation when it becomes fully mainstream (Rogers, 2003).

As explained at the start of this section, there are several issues that need to be tackled including technical, practical and organizational challenges.

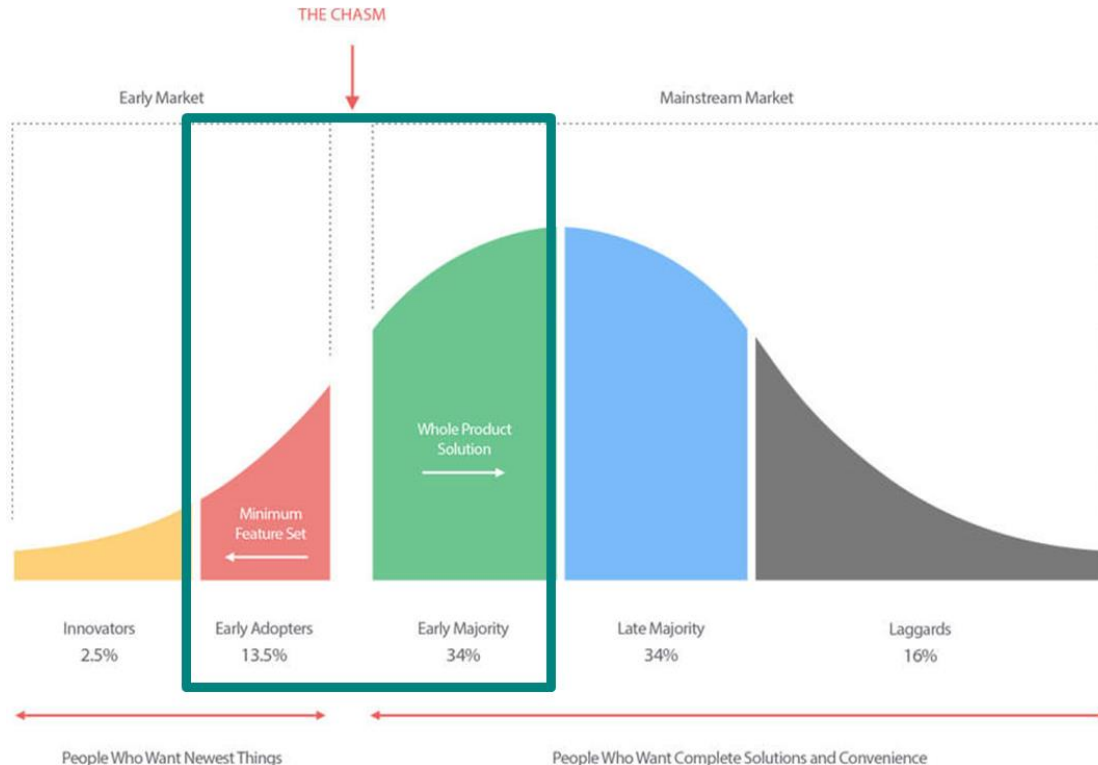


Figure 29: Rogers (2003) Innovation Adoption Lifecycle,
Picture retrieved from <http://growthstrategies101.com/index.php/2017/03/28/marketing-innovation/>

7.4.1 Long Term Roadmap for adoption

The section is consider confidential. It is therefore omitted from the public version and can be found in **PART A of the appendices section**.

7.4.2 Proposed short term actions

During the mapping of the process some “low hanging fruits” were discovered. Even though the organization is making the physical processes, it seemed as mapping administration processes is not common. Map processes across the organization would help in analysing processes and come with an integrated approach for improving them collectively. Only then there will be opportunities for standardization, digitalization and next automation. During the last two steps, blockchain can then be considered as a solution, but only after careful consideration of the alternatives.

Avoiding duplication of task between partners and handovers seemed to be the source of inefficiencies and creating a continuous improvement culture would benefit the organization in the short and long term. After all re-engineering requires an environment of continuous improvement to flourish (Steward, 1993). This could include the establishment of best practices, the use of the proposed KPIs for measurements and incentivizing the actors for providing more efficient results.

Integration among systems seems to be one of the most important improvements, especially for the side of the buyer where the use of two unintegrated ERP systems was proven to be really inefficient. Projects related to workflow management and automation of tasks should be put on high priority. Adding to this, establishment of standards when it comes to sharing data across the supply chain is crucial. Joining pilot programs regarding data sharing from ports, regulating bodies or partners would be a great way to exchange ideas and play a role in shaping the future. This would allow the company to smoothly enter the transition of the Industry 4.0.

Some recommendations as future research within Cargill, which are related to this project include:

- a) **Developing a prototype** and test it side to side with the current systems. This will serve as a way to evaluate the expected benefits with a higher accuracy, determine the actor's acceptance rate and reflect on whether the described business process is realistic solution.
- b) **Quantification of non-tangible benefits** such as reducing information asymmetry among partners or the effects of increasing traceability and transparency in the controversial palm oil industry would be an interesting task. The benefits when information regarding the quality and provenance of goods is verified via blockchain should be better understood.

In a well-known paper, written by the Nobel prize winner George Akerlof (1970), is argued that when a buyer cannot distinguish the attributes and quality of a product with a certainty,

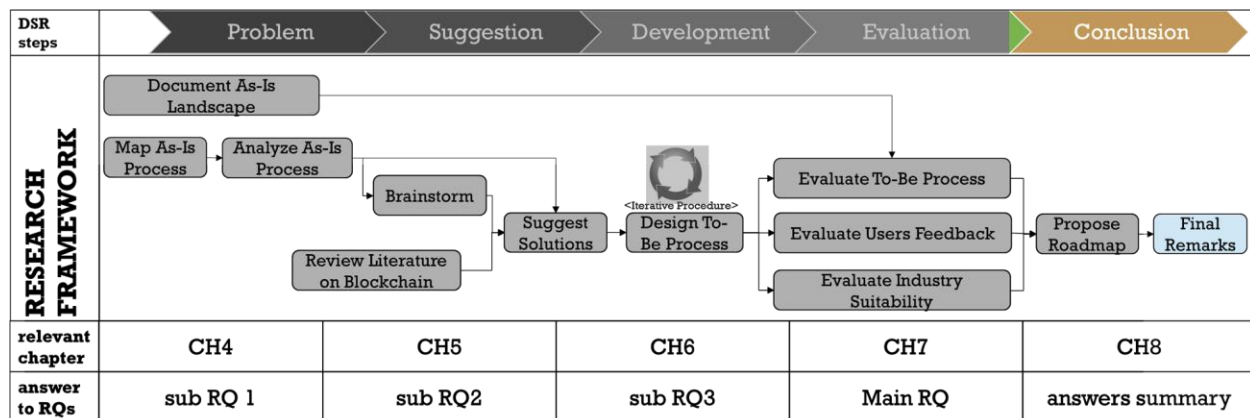
the prices of all products (both of high and good quality) will drop. This will create an adverse selection problem that will drive all the products with high quality away from the market. It would be therefore interesting to explore whether blockchain can contribute in increasing certainty in a product's quality (eg. Proof of palm oil's sustainability, quality, provenance) and how this could affect the commodity market as whole.

- c) **Mapping the full supply chain including multiple partners and external processes** would be a starting point for discovering whether and how benefits increase with network effects in the supply chain. The forward and backward integration of blockchain within the palm oil's supply chain and its related implications should be investigated.
- d) **Investigate opportunities or threats to an organization's business model.** For instance it could be investigated whether selling software as a service or optimizing a business process as a service would be a profitable choice and how are profit margins affected when a process is fully optimized. In all, the organization should decide whether a new business process should be kept for its own use or be marketed instead. When the solution is kept for private use, it could give competitive advantage and the product's value proposition might change. In case the solution is marketed instead, a totally new product (software or process as a service) could be created that will be associated with a totally new business model.
- e) **Risk mitigation plans** should be considered regarding disruptive innovations (ie.via scenario analysis) where the consequences of the several trajectories that the technology could take can be better understood. For instance, the probability of the emergence of self-organized commodity markets and an associated mitigation plan should be determined.

When considering the above mentioned short term action, the organization should further consider the possibility of partnerships, joint ventures and consortiums that could potentially speed up innovation. Related recommendations for further academic research will be presented in the next chapter.

CHAPTER 8: Conclusion

In the previous chapter, the final design was evaluated, a long term roadmap for future adoption was presented while short term actions were defined. The last chapter of the report is dedicated to answering the research questions that were established in order to meet the research objective. The limitations of the research will be then presented and the thesis will close with the topic's scientific and practical contribution, together with ideas for future academic research.



8.1 Answering the Research Questions

- **Sub Research Question 1:** What are the bottlenecks and improvement opportunities in the current business process of physical trading of crude palm oil in Cargill?

In Chapter 4, the chosen process was mapped in swim-lanes where several actors, tasks and interactions that connects them were identified. The qualitative analysis identified several non-value added (NVA) and business value added activities, as waste. The NVA activities were mostly related with handovers of tasks and documents while the BVA ones were related with checking documents that are sent from counterparties and planning activities related to lab analysis tests.

The quantitative analysis showed that employee costs, bank fees and shipping of documents were the most relevant costs. In addition, time spent on administration was considered inefficient. Furthermore, KPIs were not in place in the current process and could not guide best practices.

Improvement opportunities in reduction of administrative tasks were found where focus should be on reducing back-and-forth communication and handover between actors, minimize failure points and have the opportunity to retrieve data direct from the source.

- **Sub Research Question 2:** What kind of blockchain applications are suitable for the Physical Trading of Crude Palm Oil?

Several blockchain applications related to business processes and supply chain domain were identified. The applications that are considered to be suitable were the ones that can monitor or coordinate the supply chain flows, namely the information, physical and financial flow.

The first generation of blockchain, enables tracking assets in a transparent way which provides visibility in the supply chain. The second generation of blockchain introduces smart contracts where business logic can be replicated in blockchain supported information systems and can automate

In the case of information flows, documents can be tracked, shared and processed efficiently with counterparties. For physical flows, the product can be traced and actions can be triggered upon the oil's specifications. Financial transactions can be tracked and furthermore triggered when business logic is integrated in the smart contracts.

- **Sub Research Question 3:** How can the Business Process be re-designed once the blockchain component is introduced?

During the business process re-design the identified bottlenecks were addressed. A business process that could support inter-organizational interactions fuelled by blockchain's capabilities were considered.

In theory, the proposed design would support the proactive sharing of information, the coordination of business processes and could automatically check and evaluate data while triggering transactions related to them

Main Research Question: What kind of benefits can the application of blockchain technology bring to the inter-organizational business process of physical palm oil trading in Cargill?

The evaluation showed that the new design could enhance information sharing and it was translated in time savings for the buyer and the seller where the process can be 70-85% more efficient. The biggest benefit that a conventional database would not realize, was the automation of processes via the smart contracts functionality. It should be underlined however, that all those benefits can only be realized if information systems can be backward and forward compatible with the blockchain solution.

8.2 Thesis Contribution

The research objective of the thesis was to *explore the opportunities that blockchain could bring to inter-organizational business processes related with international supply chains and evaluate the benefits and challenges of such an application*.

The industry that was chosen to be investigated was the palm oil industry and the specific business process that was analysed was the delivery of crude palm oil, from the capture of the trade as a futures contracts, up to its unloading at the port of destination, including all related activities that determine the final payment of such a trade. After mapping and analysing the above mentioned process, examining the industry's associated environment and scrutinizing the blockchain applications that could be suitable for this case, a new business process which incorporated blockchain functionality was designed and evaluated whereupon the benefits were weighted against the drawbacks.

The main assumption was that by showing the benefits of the new design in the palm oil trade which belongs to a standardized market an insight regarding the associated opportunities of blockchain in the commodities industry could be given. After all, FOSFA contracts which are about oils, seeds and fats as well as GAFTA contracts which are covering grain trade have many similarities and are providing the rules for trading when it comes to quality standards, terms of payment, insurance, sampling, required documents etc.

The thesis contribution is presented below, in all the thesis mapped and analysed a process that was never mapped before, categorized blockchain applications that can be considered relevant in the supply chain space and evaluated the benefits of a new business process design. In all, the four gaps that were identified at the end of the literature review chapter were covered in this thesis. This included the i) mapping and analysis of the full commodity trading process, ii) classification of blockchain applications which are suitable for supply chain processes, iii) full redesign of the process supported by blockchain, iv) quantification of the potential benefits.

8.2.1 Practical Contribution

Main practical contribution of this report is the process mapping that was performed for the first time and its evaluation with the process' stakeholders which increases reliability. The analysis, the proposed KPIs to be followed and the identification of bottlenecks in administrative tasks between two different entities was also part of the contribution.

The importance of involving actors during the development stage of concepts that include radical changes was also highlighted here. It is furthermore in the authors anticipation that this work could raise awareness and incentivize more stakeholders from the commodity market in exploring the topic. The suitability of blockchain in this specific case has been further motivated while the opportunities in the supply chain as a whole were delineated. This could be used as a starting point in developing methods for discovering processes where blockchain adoption is relevant. This case was also one of the first practical demonstrations which re-imagined a complete process when blockchain can provide immutable data as well as smart contracts functionality.

8.2.2 Scientific Contribution

The scientific contribution is mostly related with the fact that this report offered a holistic view of the topic where the environment, strategy and business model of an organization was also considered. The business process perspective of blockchain was also illustrated while a suggestion for quantifying the process' gain was made and the associated benefits were mentioned explicitly. In addition, the design science research approach was evaluated as a suitable method for creating and evaluating a business process which incorporates an IT innovation, as an artefact.

Evaluation of the Design Science Research approach & filled literature gaps

Throughout the report the Design Science Research was utilized and guided the report, from mapping and analysing the process up to creating and evaluating the business process. Furthermore, several iterations were made during designing of the artefact (Kuechler & Vaishnavi, 2008; March & Smith, 1995) while the constructed artefact was compared with the existing business process (Gregor & Henver, 2013) which is in accordance with the Design Science Research principles.

In addition, the structure of the report and the way of communicating the research is also following DSR principles so that it can emphasize the contributions to the knowledge base (Gregor & Henver, 2013).

The resulting IT artefact was a business process that is redesigned so that blockchain functionality is utilized and addressing found inefficiencies. As a result, information could now be shared among two transacting parties (a buyer and a seller) in a trustable, decentralized, transparent and more efficient way. By adopting such a process, actors could interact almost real time while information asymmetry or doubts regarding the accuracy of information could be decreased.

From the DSR perspective, the contribution to the knowledge base (Henver, March, Park, & Ram, 2004) within the blockchain based business processes is accomplished through:

- extending the knowledge on the conceptual design of such an IT artefact (blockchain based business process)
- offering a novel approach where self-executed contracts are addressing inefficiencies in the inter-organizational supply chain process
- quantifying the time savings once such an artefact is adopted

The thesis is further evaluated against the DSR guidelines as proposed by Hevner et. al (2004) and the results are summarized in Table 12 in the next page.

Table 12: Evaluating the IT artefact against the DSR guidelines of Hevner et. al. (2004)

GUIDELINE:	DESCRIPTION:
Guideline 1: Design as an Artefact	The outcome of this report is a business process (artefact) which incorporates blockchain in its core for monitoring and coordinating supply chain flows in inter-organizational environments
Guideline 2: Problem Relevance	The research questions are aiming to solve a business problem by the development of a technology based solution which enables collaboration between the several actors. The problem at stake is the inefficient collaboration and information sharing between external parties during trading which is due to the information asymmetry and lack of trust which results in high transaction costs.
Guideline 3: Design Evaluation	The design is rigorously designed and evaluated throughout the report via DSR and BPR methods.
Guideline 4: Research Contributions	The research contribution is threefold: a) the proposed categorization of blockchain applications may help practitioners to realize the different uses of blockchain in the supply chain domain, b) the mapping and analysis facilitated the understanding of deficiencies in the current inter-organizational processes c) the re-engineered business process extended the knowledge in BPM and the domain of blockchain-based information systems where: i) a relevant process was identified, ii) the expected benefits were quantified, iii) a proof-of-concept leveraging opportunities offered by blockchain was created, iv) a holistic view of the business process was presented,
Guideline 5: Research Rigor	During the construction and evaluation several rigorous methods were applied. The DSR method was adopted whereupon principles related to Business Process Management were also followed
Guideline 6: Design as a Search Process	In order to answer the research questions, relevant literature was used and the solution was build upon literature review together with several iterative rounds based on feedback from the involved actors.
Guideline 7: Communication of Research	The communication of the research is achieved by the publication of the thesis and the outcome of this report can be presented to both management oriented and technology oriented audience.

8.2.3 Contribution as a Management of Technology thesis

Management of Technology graduates should be able to understand how organizations can utilize technology to their advantage so that their performance can be improved either qualitatively or quantitatively (TU Delft, 2018). This paper tried to perform exactly this: understand, explore and evaluate blockchain technology in a specific business process within the palm oil supply chain. It suggested that by utilizing blockchain technology, specific benefits could be realized within a network of organizations. Those organizations were the product's buyer and seller but it could possibly expand to the whole supply chain if the full network is included. Next to this it raised concerns and provided advice regarding the technology's future implementation.

The master thesis project should be evaluated against specific criteria which serve as guidelines for master thesis assessment. Graduation criteria given from the TBM faculty stipulate that the thesis should:

- i) *contain an analytical component,*
- ii) *be multidisciplinary in nature*
- iii) *focus on a technical domain or application.*

Specific to Management of Technology the dissertation should report on a scientific study in a technological context, show the corporate perspective of an innovation or technology and prove its understanding while scientific methods and techniques that were learned throughout the MoT studies are used (TU Delft, 2017).

The thesis did indeed contain an **analytical component**, since the way the topic was divided into several elements helped to demarcate the problem and reach to conclusions in a deductive manner. This was accomplished by splitting the research objective into several research questions, following the research framework that was presented earlier in chapter 2 and adopting several methods and tools in order to reach the research objective.

Most of the scientific methods and techniques used throughout the thesis were taught in several courses during the Management of Technology master. The difficulty of the thesis did not only lie to the novelty of the technology but also to the fact that the practical problem (inefficient transactions among stakeholders in global trade) had to be carefully analysed.

Furthermore, the research was proven to be **multidisciplinary** in nature. It covered several disciplines and required the understanding of a technology that emerged from Computer Science

and Mathematics field and it additionally followed principles from Supply Chain Management and Business Process Management in order to map, analyse and re-design the business process.

In addition, there was a **special focus on the application of a blockchain as a technology** in a specific business processes of the supply chain domain where a corporate perspective of the technology was taken.

The technology was understood and explained in simple terms and the main focus was to debunk it and determine its potential value from a business perspective. For this matter, the emerging new design that incorporated blockchain was then evaluated against the old business process as well as the business model and strategy of the organization.

8.3 Limitations & Challenges during the research

During the writing of this report there were several limitations and challenges to be tackled which are presented in this chapter. Those limitations were regarding the fact that there was:

- a) restricted access to the process' external stakeholders
- b) limited availability of data
- c) a time and scope limitation

Those limitations are elaborated below.

8.3.1 Limitations in access to external expert's input

During the re-design of the process, some actors were assumed to provide data input for the process (eg. Certificate of Analysis from the surveyor) while their full actions were not re-designed. This was due to two practical reasons. First, the scope had to be limited while at the same time the benefits had to be proved. Second, the engagement from those stakeholders would have been essential when re-designing their processes, but **due to the confidential nature of the project, feedback from external stakeholders was not be possible.**

In addition, feedback from partners or competitors would have been useful since they could offer a case specific feedback but they would be expected to have a slightly different perception of the topic due to the different company culture they have been exposed. This would contribute into ensuring that the designed solution would fit to the whole market. Concerns regarding the implications of the market as a whole when such an innovation takes over could also be raised.

Discussing the findings with actors from another industry which is less conservative, smaller (therefore more agile), more innovative and more prompt to undergo radical changes would have given another perspective into what is possible regarding organizational change or technological transformation. In order to tackle those limitations, the author attempted to seek for answers in the relevant literature instead.

8.3.2 Limitations in data collection

The contracts that are followed for a palm oil trade are quite standard and easy to find. There was however an **unavailability of qualitative information** regarding the internal administration procedures followed and how those procedures are connected with each other was not provided in a structured way. Therefore, since the process was not mapped earlier, extra time was required for mapping, analysing and evaluating the findings with the involved actors.

Another limitation was the **unavailability of quantitative data**. Hence, making a reliable quantitative analysis was not trivial since there were no data available and the actors could only provide their estimates based on their perception which is not always accurate. Since there were no KPIs for best practices, the author had to establish them and some of them were chosen to be analysed further. Due to the time, scope and geographical limitations (the seller is based in Singapore), the time was chosen to be estimated rather than accurately tracked.

The unavailability of reliable literature sources was also considered as a limitation. During the first months of the thesis, there were only few sources available. Throughout the project, the novelty, immaturity and hype around blockchain technology caused the literature to skyrocket and the literature review was a continuous procedure where the author was constantly alert for new publications.

Filtering the several sources was a great challenge. For example, the information found in conference proceedings was fresh but not always reliable. For instance, the solutions that the technology could offer was not made implicit in most cases while in other cases the whole notion of blockchain capabilities was misinterpreted. In addition, due to the fact that a hype was created this year, some researchers seemed rushing in publishing unfinished work which was still lacking rigor.

8.3.3 Limitations in time & scope

The report was tabulated within a specific time period in order to comply with the master's guidelines. Even though it is considered appropriate as a master thesis, **its 6-month time limitation** does not enable an exhaustive analysis of the topic. Furthermore, a **multidisciplinary rather than a pure Business Process Management approach** was followed. This was due to the fact that the researcher intended to provide the reader with a spherical view of the topic which is also in accordance with the MoT assessment criteria. A pure BPM approach would fit best within either a Computer Science or a Business Administration discipline.

In addition, the **volume of documents and data elements** together with the fact that organizations such as Maersk or Port of Rotterdam already performed such an activity, discouraged the author to dive further into the specifics even though mapping of those elements might be proven to be vital for the future of blockchain within international supply chains.

Mapping the full process including all stakeholders would also be constructive where the benefits of a re-design of the full ecosystem could have been considered as a whole. However, **mapping the complete process would add complexity**. As an indication, mapping the interactions among 20 parties could result to more than 190 interactions if we assume bilateral interactions and each party interacting with all parties at least one time. Increasing the involved parties from 20 to 30, would result to 435 possible interactions! ³

Those interactions would probably make the content unmanageable, it would possibly disorient the researcher's focus in proving the value of the technology and would increase the required time for completing the research exponentially, possibly turning it from a master thesis to a PhD!

³ In reality not all actors would interact with each other. In addition, some actors would interact multiple times with some parties while disturbances and errors in the process could activate a chain reaction that would make multiple parties interact with each other to solve the issue. The upper example was used for illustrative purposes to show the increase in complexity. The combination formula was used: $C(n, r) = \frac{n!}{(n-r)!r!}$, where C is the number of actors interactions occurring when an n number of involved actors are combined (interacting) in groups of r

8.4 Future Research

To start with, it would be suggested to map the full process of crude palm oil's trading including all stakeholders and associated tasks. In that way, the deficiencies and implications of the supply chain process as a whole can be identified. Furthermore, it can be shown whether and how network effects increase the benefits of such a blockchain implementation and weigh it against the risks associated with the increase in complexity.

Example of those processes would be mapping the customs clearance procedure, bank payments, surveyor's tasks or port activities and determine how each process interacts with each other in terms of actors and data elements. Involving stakeholders from those activities would be crucial.

Regarding the current work, the cost of such an implementation should be estimated and compared to other solutions. Next, the cost should be compared with the risk associated in case it comes to production. The contents of the process were verified by the actors. It would be interesting to evaluate further the consistency of the new design by using for instance the DEMO method (Caetano, Assis, & Tribolet, 2012; Dietz J. , 1999).

In addition, collecting more accurate quantitative data (eg. data from event logs) regarding the time required for each task could be used for evaluating the accuracy of the findings in this report and can further be used for creating interactive business process maps. A process mining approach could contribute in detecting bottlenecks of the as-is process but can also support predictive analytics (van der Aalst, 2009) for projecting the benefits of blockchain adoption together with several new to-be situations such as traditional automation of tasks or the benefits of interoperability among systems (eg. ERP systems).

Another suggestion would be mapping the process of similar commodities such as coconut or palm kernel oil and determine whether the conclusions can be expandable to other products while the challenges of the regulatory and legal environment as a whole could be evaluated. It can then be assessed whether smart contracts could be ever legally enforceable. Data mining or other related methods that can help to categorize blockchain applications could also be considered, so that a universal taxonomy of applications can emerge.

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