BLOCKCHAIN AND SUPPLY CHAIN TRANSPARENCY

A case study on utilizing blockchain technology as a platform for transparency

Course Coordinator: Jacob Nørbjerg
Supervisor: Michel Avital

Date: March 15, 2017

Pages including appendix: 83
Characters: 94025

Study Programme: Msc in Business Adminstration and Information Systems

John Schwartz Jacobsen
joja08ab – Master Thesis

CBS COPENHAGEN BUSINESS SCHOOL
HANDELSHØJSKOLEN

Declaration of Authorship

(To be placed at page 2 in the assignment])

Identification	
Title of assignment:	Blockchain and Supply Chain Transparency
Study programme:	Msc in Business Administration and Information Systems
Course:	KAN-CINTO1005U Master's Thesis
Type of Exam (e.g. Home assignment or Bachelor Project):	Thesis

Social Security No. or Student ID:	Name of author(s):	Group no. (if relevant)
100986-XXXX	John Schwartz Jacobsen	

Number of pages:

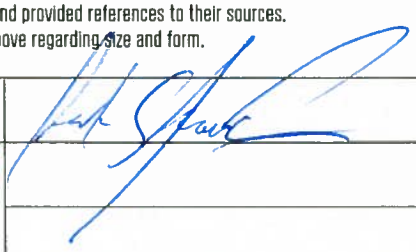
According to the exam regulations for this particular exam, the assignment must be of a maximum of 80 pages (Insert max. number of pages) exclusive front page, bibliography and appendices. Appendices are not included in the assessment.

Each individual page of the assignment may not comprise more than 2,275 characters (incl. spaces) on average. (E.g. similar to 35 lines of 65 characters). All pages must have a margin of min. 3 cm in top and bottom and min. 2 cm to each of the sides. The fount must be of a minimum of 11 pitch. Tables, diagrams, illustrations etc. are not included in the number of characters, but will not justify exceeding the maximum number of pages.

Code of conduct:

Undersigned author hereby declare:
- that I/we individually or together with the group members listed above have written and completed this assignment.
- that I/we have indicated all quotes with quotation-marks and provided references to their sources.
- that the assignment complies with all regulations stated above regarding size and form.

Date: 15-03-2017 Signature(s):



Abstract

A future challenge in the pharmaceutical industry is the implementation of the Falsified Medicine Directive proposed by the European Commission, which imposes a new system of authenticating medicinal products in the pharmaceutical supply chain. The implementation of the new system will change the way the supply chain functions and adds new ways of introducing transparency throughout the supply chain.

This research will compare the features and functionalities of Blockchain technology to the regulatory requirements of the pharmaceutical industry and to the demands of the firms in the pharmaceutical supply chain. The possibility of using Blockchain technology for improving the documentation requirement set by the Good Distribution Practices guidelines and further improve transparency is also investigated.

An attempt is made to produce a simple design where Blockchain technology could be used to meet regulatory and business demands within the pharmaceutical industry, with the additional goal of improving transparency in the supply chain.

This thesis uses a case study approach. Through a literature review covering supply chain management and transparency, and empirical data gathering through interviews and documents, the regulatory and business demands in the pharmaceutical industry is presented.

Through a review of the features and capabilities of Blockchain technology, the requirements gathered through literature review and empirical data are compared and a system design will be proposed. This system design will be simple and will not account for the minutia in the regulatory requirements, but will focus on the larger issues such as documentation and authentication.

This thesis will show a theoretical basis for using Blockchain technology in the pharmaceutical supply chain to handle authentication of a medicinal product and the documentation required to follow the medicinal products. By incorporating standards, such as GS1, the Blockchain system could be better equipped to handle current practices within the pharmaceutical supply chain and provide a greater level of transparency to all supply chain partners.

The thesis acknowledges, that the infancy of the Blockchain technology is a challenge. Another challenge is the shift from a centralized paradigm to a distributed, decentralized paradigm. Before putting Blockchain technology in use on a larger scale further research is needed.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 Introduction

Transparency has been by many defined as the disclosure of information. However, transparency can come in many forms. One form of transparency comes from a very familiar situation: the receipt. When shopping at any store, after the purchase one is usually offered a receipt stipulating what has been purchase at what cost (Wikipedia, 2016). Another form of transparency is the disclosure of a firm's suppliers or customers. Here the goal of the transparency can be regarding organic foods, forced labor or sustainability regarding to the production.

There has been much research regarding transparency in supply chains, especially within the agri-food domain. Research has shown that transparency can have critical impact on business processes and regulations. The 2013 horsemeat scandal could be used as an example of when things go wrong.

In 2013, horse DNA was found during a regulatory inspection by the Food and Safety Authority of Ireland (FSAI) (Food and Safety Authority of Ireland, 2013). This inspection specifically tested foods for the presence of horse and pig DNA in beef burger products, where horse DNA was found. From a health standpoint, there was no need for concerns according to FSAI, however they had trouble figuring out how horse DNA entered the supply chain. This resulted in millions of beef burger products being taken of the shelves (The Guardian, 2013).

In the field of medicine, there are challenges with counterfeit drugs. As of October 2015, the Falsified Medicine Directive was published, carrying a deadline of February 2019. The main points laid forward by this directive are that safety features should be present on all unit-level products of medicine; a 2D barcode carrying a unique identifier, which can be referenced in a centralized system, to determine the provenance of the product, and an anti-tampering device present on the packaging.

While the pharmaceutical industry reacts to the new regulations, there is still the discussion on what solutions should be implemented, to make the firms in the pharmaceutical supply chain compliant to the new regulations. The Danish pharmaceutical industry has yet, at the time of writing, to decide on how to become compliant with the EU directive.

Currently, there are many companies and consortiums that are attempting to utilize blockchain technology to improve the way supply chain visibility is managed. However, is seems that there is little to no knowledge regarding this in Denmark. It should be noted that blockchain technology is still in its infancy and may not be available at the EU deadline of February 2019 regarding the regulated IT system proposed in the EU Falsified Medicine Directive.

1.1 Problem Statement

Currently, regulations force firms in the pharmaceutical industry to provide a certain level of transparency. Medicine introduced to the EU markets will be required to be labelled with a 2D barcode, carrying a unique product identifier, serial number, lot or batch number, and an expiration date. When a product is introduced to the EU market, every product item must be registered in a cross-national database. The goal of this, is to prevent the entry of counterfeit products into the legal supply chain. Once a product has been issued or sold to the public for consumption, the pharmacy or a similar entity is responsible for registering the product item from the cross-national database as sold, indicating that the product item is no longer in the supply chain. The distributers must verify all purchased medicinal products against the cross-national database, whenever they suspect that the medicinal products might be counterfeit. Every time anyone accesses the cross-national database, it is to verify that the products they hold are genuine.

One of the challenges regarding this, is sharing the information to all relevant parties. The EU Falsified Medicine Directive proposes a reference system architecture, to disseminate the necessary information to all parties.

Part of the purpose of this thesis, is to research whether the features and capabilities of blockchain technology can be used within the pharmaceutical industry. After this, attempts to compare the features with the requirements set forth by EU regulations, and the demands of the pharmaceutical industry will be made. With these features in mind, this thesis will provide a simplified reference system architecture based on blockchain technology.

1.2 Research Goal

This thesis will attempt to highlight the current perspectives regarding transparency, specifically geared towards the technological implementation of transparency in the pharmaceutical industry. The pharmaceutical industry is currently working hard towards becoming compliant with the Falsified Medicine Directive. Some challenges include decisions on which solutions should be implemented.

Attempts wil be made to compare the requirement set forth by Falsified Medicine Directive and other perspectives gained from the pharmaceutical industry, to current and proposed capabilities of blockchain technology. Based on the comparison between regulatory and industry requirements, and the capabilities of blockchain technology, this thesis will propose and highlight methods in which blockchain technology could be used.

1.3 Research Objectives

To reach the research goal, this thesis will do so by accomplishing these research objectives:

1. Explore existing literature regarding supply chain management, to gain an understanding how a firm cooperates with its supply chain partners.
2. Explore and research the perspectives from persons within the pharmaceutical industry, regarding the current state of transparency in the pharmaceutical supply chain.
3. Explore the features and capabilities of blockchain technology.
4. Based on the previous objectives, the viability of using blockchain technology in the pharmaceutical industry will be analyzed.

1.4 Research Question

Through the research goal and objectives, the research question this thesis will to answer is:

> How can blockchain technology be used (or leveraged) to provide transparency in supply chains of material goods?

First, we must establish what a supply chain is and how to manage it. Then, after determining what transparency is, we must establish what transparency in a supply chain is. After clarifying the concept of supply chains and transparency, we can move on to blockchain technology. At this stage, we determine the features or capabilities inherent in blockchain technology.

Another important step is regarding the pharmaceutical industry. Part of the new regulations, as well as current practices, is to verify the authenticity of products. This verification process is important to understand.

1.5 Delimitations

This thesis will not attempt propose a fully functioning system, as the blockchain technology is still in its infancy and by the time this thesis is being written, the features proposed by blockchain technology may have been changed. Furthermore, there are already many different startups and established companies working on solutions that integrate blockchain technology that can increase transparency or improve overall supply chain management.

The amount of research available within the domain is high and diverse with respect to transparency. Therefore, no attempts to propose new theories in regards to transparency will be done in this thesis.

2 Literature review

In this section, the theoretical propositions and practical issues that will become part of the case study will be studied. First, a summary of supply chain and supply chain management theory will be presented. Second, a description of Transparency and the challenges and opportunities it proposes. Third, a perspective of transparency within supply chains will be presented. Lastly, a brief overview of Blockchain technology and the its main components will be presented.

2.1 Supply Chain Management (SCM)

According to Mentzer, et al, a supply chain is defined as: "a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from source to customer" (Mentzer, et al., 2001). Additionally, they identify three degrees of supply chain complexity: direct supply chain, extended supply chain, and ultimate supply chain.

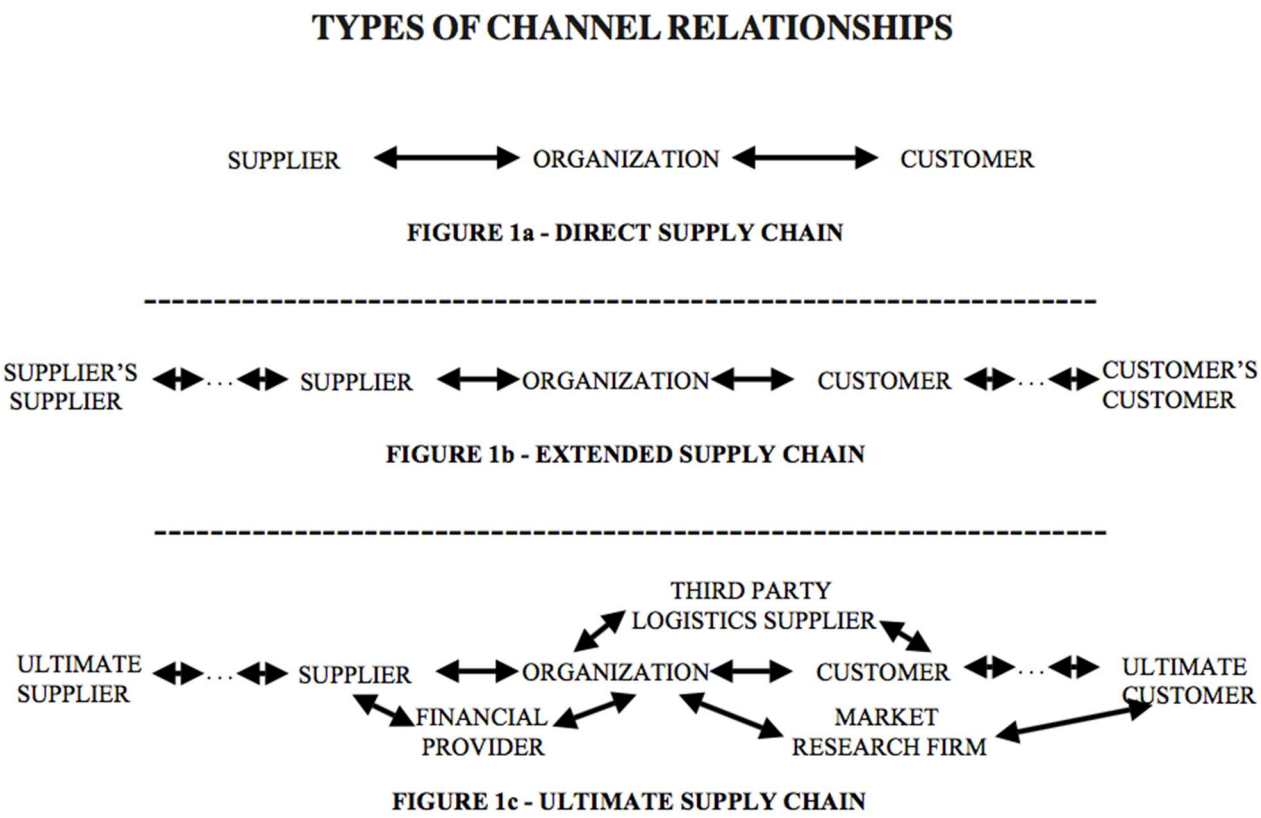


Figure 1 Degrees of supply chain complexity (Mentzer, et al., 2001)

It is important to note that if a firm is only aware of the implications of managing a supply chain, but takes no action towards in managing the supply chain, then the firm does not have supply chain management,

but supply chain orientation. Therefore, a firm can only undertake supply chain management, if it first has supply chain orientation.

2.1.1 SCM as a Management Philosophy

Per Mentzer, et al, SCM as a management philosophy has the following characteristics (Mentzer, et al., 2001):

1. A systems approach to viewing the supply chain as a whole, and to managing the total flow of goods inventory from supplier to the ultimate customer;
2. A strategic orientation towards cooperative efforts to synchronize and converge intrafirm and interfirm operational and strategic capabilities into a unified whole; and
3. A customer focus to create unique and individualized sources of customer value, leading to customer satisfaction.

The systems approach of viewing the supply chain as a single entity, bears other implications. In this perpective, a member of the supply chain can affect the performance of other members in the supply chain, and ultimately affect the overall performance of the supply chain (Mentzer, et al., 2001). The strategic orientation means, in other words, that cooperation between supply chain members to create individualized and unique sources of customer value is essential (Mentzer, et al., 2001). Lastly, the customer focus requires that the supply chain members understand the customers' values and requirements (Mentzer, et al., 2001).

2.1.2 SCM Activities to Implement the Philosophy

To embrace the SCM philosophy, authors of the supply chain literature has proposed a list of activities that are necessary for firms to adopt (Mentzer, et al., 2001).

SCM Activities
Integrated Behavior
Mutually Sharing Information
Mutually Sharing Risks and Rewards
Cooperation
The Same Goal and the Same Focus on Serving Customers
Integration of Processes
Partners to Build and Maintain Long-Term Relationships

Table 1 SCM Activities (Mentzer, et al., 2001)

2.1.2.1 Integrated Behavior

Authors have argued that to be effective in today's competitive environment, firms must expand their integrated behavior to incorporate customers and suppliers, and coordinate their efforts among supply chain members to dynamically respond to the needs of the end customers (Mentzer, et al., 2001).

2.1.2.2 Mutually Sharing Information

Linked to the previous section about integrated behavior, it is imperative that information be shared, to plan and monitor the efforts made towards reaching the needs of the end customer. Also by sharing information between supply chain members, it reduces the uncertainty between members and enhances performance. Specifically, sharing information can include inventory levels, forecasts, sales promotion strategies, and marketing strategies (Mentzer, et al., 2001).

2.1.2.3 Mutually Sharing Risk and Rewards

To gain a competitive advantage in the marketplace, supply chain members should share the risks and rewards of serving the needs of the end customer. Sharing risks and rewards is important for long term focus and cooperation among the supply chain members (Mentzer, et al., 2001).

2.1.2.4 Cooperation

To make the supply chain more effective, cooperation is needed among the supply chain members. Cooperation refers to complementary, coordinated activities performed by the firms in a business relationship to produce a superior outcome (Mentzer, et al., 2001).

Cooperation normally starts with joint planning and ends with joint control, enabling the evaluation of the performance of the supply chain members, as well as the whole of the supply chain. In addition, cooperation is required to reduce inventories across the supply chain, and pursue supply chain-wide cost-efficiencies. Furthermore, supply chain members can cooperate in the product development (Mentzer, et al., 2001).

2.1.2.5 The Same Goal and The Same Focus on Serving Customers

By sharing the same focus and goal on serving the end customers, a firm enters a form of policy integration among its supply chain partners. This integration helps to avoid overlaps and redundancies in the supply chain, while also improving efficiency and lowering costs (Mentzer, et al., 2001).

2.1.2.6 Integration of Processes

To implement SCM, it is necessary to integrate processes among the supply chain members. The integration can be accomplished by implementing cross-functional teams, in-plant supplier personnel, and third party providers.

Additionally, there are four stages of supply chain integration (Mentzer, et al., 2001):

- Stage 1: The base line. The supply chain is a function of fragmented operations within the individual company, characterized by staged inventories, independent and incompatible control systems and procedures, and functional segregation.
- Stage 2: Focus is turned to internal integration, characterized by an emphasis on cost reduction rather than performance improvement, buffer inventory, initial evaluations of internal trade-offs, and reactive customer service.
- Stage 3: Reaching toward internal corporate integration and full visibility of purchasing through distribution, medium-term planning, tactical rather than strategic focus, emphasis on efficiency, extended use of electronics support for linkages, and a continued reactive customer service.
- Stage 4: Achieving supply chain integration by extending the scope of integration outside the company to embrace suppliers and customers.

2.1.2.7 Partners to Build and Maintain Long-Term Relationships

Effective SCM is made of relationships and partnerships between supply chain members. The relationship time horizon is argued to be longer than the life of any contract – perhaps indefinitely (Mentzer, et al., 2001).

2.1.3 SCM as Management Processes

Authors suggest that SCM is the process of managing relationships, information and material flows across enterprise borders to deliver enhanced customer service and economic value through synchronized management of the flow of goods and associated information from source to consumption (Mentzer, et al., 2001). Other authors define a supply chain process as the actual physical business functions, institutions, and operations that characterize the way a supply chain moves goods and services to market through the supply chain pipeline (Mentzer, et al., 2001). In short, a supply chain process is a specific ordering of work activities across time and place, with a beginning and an end, clearly identified inputs and outputs, and a structure for action (Mentzer, et al., 2001).

To successfully implement effective SCM, authors suggest that firms overcome their own functional silos, and adopt a process approach. Therefore, making all functions within the supply chain a key process. Each key process is focused on meeting the customer's requirements, and the firms are organized around these processes (Mentzer, et al., 2001).

2.1.4 Antecedents to SCM

Per Mentzer et al (2001), Supply Chain authors propose some key antecedents prior to SCM. These are:

- Trust
- Commitment
- Interdependence
- Organizational Compatibility
- Vision
- Key Processes
- Leader Role
- Top Management Support

2.1.4.1 Trust

Trust is defined as "the willingness to rely on an exchange partner in whom on has confidence" (Mentzer, et al., 2001). Trust also has direct and indirect relationship with commitment. The role of trust is to overcome mutual difficulties, such as power, conflict, and lower profitability. Therefore, trust influences the sharing of risks and rewards (Mentzer, et al., 2001).

2.1.4.2 Commitment

Commitment is defined as "an implicit or explicit pledge of relational continuity between exchange partners" (Mentzer, et al., 2001). Commitment is essential for successful long-term relationships which are a component of the implementation of SCM.

Trust and commitment are key components in the implementation of SCM, because "they encourage marketers to (1) work at preserving relationship investments by cooperating with exchange partners, (2) resist attractive short-term alternatives in favor of the expected long-term benefits of staying with existing partners, and (3) view potentially high-risk actions as prudent because of the belief that their partners will not act opportunistically" (Mentzer, et al., 2001). Trust and commitment to implementing SCM therefore fosters a cooperative behavior among the supply chain members (Mentzer, et al., 2001).

2.1.4.3 Interdependence

Interdependence refers to the firm's need to maintain a relationship with a partner to achieve the firm's goals. This dependence also encourages and motivates the willingness to share key information and participate in joint operational planning (Mentzer, et al., 2001).

2.1.4.4 Organizational Compatibility

Organizational compatibility is defined as "complementary goals and objectives, as well as similarities in operating philosophies and corporate cultures" (Mentzer, et al., 2001).

2.1.4.5 Vision

By having a vision, supply chain members are provided with specific goals and strategies on how to identify and realize the opportunities found in the marketplace (Mentzer, et al., 2001).

2.1.4.6 Key Processes

A process within a firm refers to the combination of a set of business functions that produce a specific output. It is suggested that all traditional business functions should be included in the process of SCM. For example, logistics is a single business function, but it is also a part of the overall supply chain functions (Mentzer, et al., 2001).

2.1.4.7 Leader

Within a supply chain, it is necessary that there is a leader among the supply chain members. The leader role consists of coordinating and overseeing the whole supply chain (Mentzer, et al., 2001).

2.1.4.8 Top Management Support

Mentzer et al suggests that top management support play a key role in the successful shaping of an organizations values, orientation and direction (Mentzer, et al., 2001).

2.1.5 Consequences to SCM

Mentzer et al proposes that the consequences of implementing SCM, are the following:

- Lower Costs
- Improved Customer Value and Satisfaction
- Competitive Advantage

2.1.5.1 Lower Cost and Improved Customer Value and Satisfaction

A key objective of SCM is to lower the costs required to provide the necessary customer service. Another key objective is to improve the customer service through increased stock availability and reduced order cycle time. Customer service objectives are accomplished through customer-enriching supply system focused on developing innovative solutions and synchronizing the flow of products, services, and information to create unique and individualized sources of customer service value. Low costs and differentiated services help build competitive advantages for the supply chain (Mentzer, et al., 2001).

2.1.5.2 Competitive Advantage

Michael Porter in his book from 1985 "The Competitive Advantage: Creating and Sustaining Superior Performance", proposed that there are two types of competitive advantages: cost leadership and differentiation (Mentzer, et al., 2001). Other authors argue that competitive advantage through SCM is accomplished by enhancing overall customer satisfaction (Mentzer, et al., 2001). Here, Porter agrees by arguing that competitive advantages fundamentally come from the customer value that a firm creates (Mentzer, et al., 2001). Therefore, "it is proposed that the implementation of SCM enhances customer value and satisfaction, which in turn leads to enhanced competitive advantage for the supply chain, as well as each member firm. This, ultimately, improves the profitability of the supply chain and its members" (Mentzer, et al., 2001).

2.1.5.3 Supply Chain Summary

Summing up on literature supply chain management, Mentzer et al, provides this definition: "supply chain management is defined as the systematic, strategic coordination of the traditional business functions and the tactics across these business functions with a particular company and across businesses within the supply chain, for the purposes of improving the long-term performances of the individual companies and the supply chain as a whole" (Mentzer, et al., 2001).

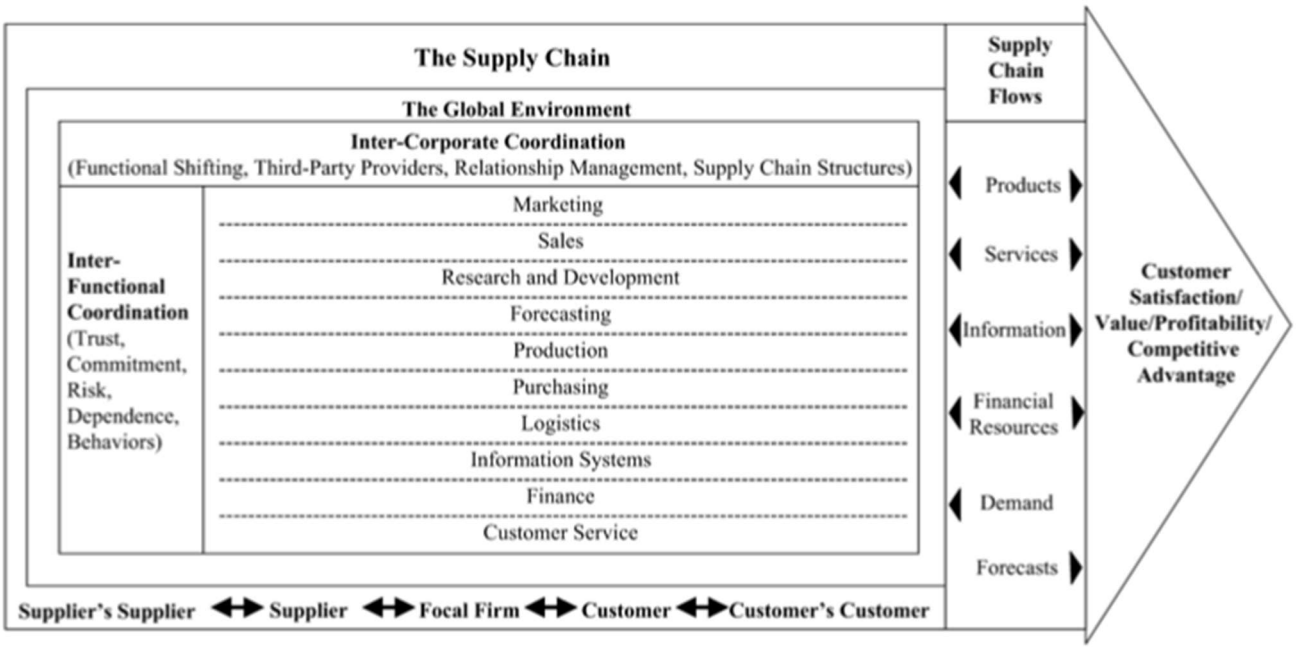


Figure 2 A model of Supply Chain Management (Mentzer, et al., 2001)

2.2 Transparency

In general, transparency has been defined as "the disclosure of information" (Mol, Transparency and value chain sustainability, 2015; Schnackenberg & Tomlinson, 2016). It has also been described as "revealing truth, promising a better world for all" (McGirvern & Fischer, 2012). Usually, transparency is presented as a neutral device for increased openness, but it is important to remember that transparency is inherently political because of their construction and applications (McGirvern & Fischer, 2012).

2.2.1 State of Transparency Research

There has been a disparity in what constitutes transparency. A recent study set out to merge existing literature from the different research domains, where a generalized definition of transparency was proposed (Schnackenberg & Tomlinson, 2016):

> "Transparency is the perceived quality of intentionally shared information from a sender" (Schnackenberg & Tomlinson, 2016, p. 1788)

During an examination of the current literature in their research, Schnackenberg and Tomlinson suggests that researchers have conceptualized transparency in three primary ways: *disclosure*, *clarity*, and *accuracy* (Schnackenberg & Tomlinson, 2016).

2.2.1.1 Disclosure

Per Schnackenberg and Tomlinson, "*Disclosure* is defined as the perception that relevant information is received in a timely manner" (Schnackenberg & Tomlinson, 2016, p. 1792). Disclosure implies that the information is openly shared for it to be considered transparent. However, it also implies careful consideration of what information is most relevant to disclose (Schnackenberg & Tomlinson, 2016).

2.2.1.2 Clarity

Clarity is "the perceived level of lucidity and comprehensibility of information received from a sender" (Schnackenberg & Tomlinson, 2016, p. 1792). The difference between disclosure and clarity lies in that clarity focuses on the transfer of meaning, rather than the amount or relevance of information (Schnackenberg & Tomlinson, 2016).

2.2.1.3 Accuracy

"*Accuracy* is defined as the perception that information is correct to the extent possible given the relationship between sender and receiver" (Schnackenberg & Tomlinson, 2016, p. 1793). Accuracy is focused on the reliability of the information rather than its completeness or understandability. However, it is not implied that information must be completely correct *ex post* to be considered transparent (Schnackenberg & Tomlinson, 2016).

Transparency covers a wide domain. Therefore, I will focus on my attention on the application of transparency with regards to supply chains, specifically regarding disclosure of information.

2.2.2 Transparency Types

There are four ideal types of transparency: management-, regulatory-, consumer-, and public transparency (Mol, Transparency and value chain sustainability, 2015).

2.2.2.1 Management Transparency

This version of transparency has its origins in the management sciences and logistics (Mol, Transparency and value chain sustainability, 2015). This can be seen in the practical application of theories such as Total Quality Management, traceability in supply chains, and verification of product specification (Mol, Governing China's food quality through transparency: A review, 2014). The level of transparency is usually limited to actors within the value-chain, and is as such not available to the public (Mol, Governing China's food quality through transparency: A review, 2014; Mol, Transparency and value chain sustainability, 2015).

2.2.2.2 Regulatory Transparency

The regulatory type of transparency relates to the requirements set by regulatory bodies, demanding disclosure of certain information (Mol, Transparency and value chain sustainability, 2015). Examples of this are track-and-trace policies or provenance information.

It is argued that regulators use transparency standards to affect professionals' attention on "doing the right thing", thereby affecting and controlling the norms of professional practices (McGirvern & Fischer, 2012).

2.2.2.3 Consumer Transparency

This type of transparency involves the disclosure of product information and production, often related to claims of sustainable production processes. These disclosures often result in some form of labelling or certification of products or processes (Mol, Transparency and value chain sustainability, 2015).

2.2.2.4 Public Transparency

In this form of transparency, the information is disclosed in a wider public domain (Mol, Transparency and value chain sustainability, 2015). The information disclosed often has the goal of legitimizing a firm's production and processes, while also attempting to safeguard the reputation of the firm. Furthermore, the information disclosed also serves to defend the claims of sustainability and the labels used by the firm, as a competitive advantage (Mol, Transparency and value chain sustainability, 2015).

While all four types are relevant, this thesis will focus only on the two first types of transparency.

2.3 Supply Chain Transparency

As described in section 2.2, transparency is the disclosure of information. While the literature on this subject is vast, this thesis will borrow from one model of supply chain transparency: The Supply Chain Disclosure Radar (Marshall, McCarthy, McGrath, & Harrigan, 2015). This model consists of four information disclosure types: Membership, Provenance, Environmental Information, and Social Information. Specifically, this thesis will focus on the first two types of information disclosure: Membership and Provenance. Below the information disclosure types will be introduced.

2.3.1 Membership

Membership refers to information regarding a firm's suppliers and trade partners. Sometimes it is only the direct suppliers of the firm which is disclosed, but in other cases, i.e. Nike has disclosed the comprehensive supplier list, including the location of and break down of lower-tier suppliers, for its entire product range (Marshall, McCarthy, McGrath, & Harrigan, 2015).

2.3.2 Provenance

Provenance refers to disclosure of information regarding the materials used in the production of a product, the source location of the materials, and details on how the materials are extracted or produced (Marshall, McCarthy, McGrath, & Harrigan, 2015). Most commonly, this is done to meet regulatory or professional standards.

2.3.3 Environmental Information

Firms that include a corporate responsibility strategy, report and disclose information regarding their environmental impact. This could include information such as carbon emissions, energy usage, water usage, levels of waste produced in the supply chain (Marshall, McCarthy, McGrath, & Harrigan, 2015).

2.3.4 Social Information

In this case, organization provide information regarding labor policies, human rights, and social impacts within the supply chain (Marshall, McCarthy, McGrath, & Harrigan, 2015). Information regarding labor policies may include work hours, holidays, wages, benefits, working conditions, and health and safety reports. Information regarding human rights may include child labor, forced labor, freedom of association, and nondiscrimination. Information regarding social impact may include anti-corruption policies, impact on local communities, local engagement and development programs, and noncompliance with rules and regulations (Marshall, McCarthy, McGrath, & Harrigan, 2015).

2.4 Blockchain Technology

Blockchain technology – or public ledger technology – is a field of interest for many first movers. First introduced as the backbone of Bitcoin, the peer-to-peer electronic cash system (Nakamoto, 2008). Bitcoin was introduced in 2008 as a virtual cryptocurrency. The big selling point of this new currency was that it had no intermediaries. Currency is transferred directly from peer to peer. The technology behind Bitcoin was tailored specifically to allow transactions to occur without the need of trust or a trusted intermediary (Nakamoto, 2008). This enables any actor to transfer currency independently from the normal centralized institutions.

2.4.1 Bitcoin Technology Stack

While it may be confusing for some, Bitcoin used to be a definition of three separate things. First, Bitcoin referred to the underlying blockchain technology platform. Second, it referred to the protocol that runs on top of the blockchain technology platform, which describes how assets are transferred between parties on the blockchain. And third, it referred to the digital currency, Bitcoin (Swan, 2015). Below each of these are reviewed in turn.

2.4.1.1 The Underlying Technology – The Blockchain

At the bottom of the stack, is the blockchain technology platform. The blockchain is the decentralized transparent ledger, which holds all the transactions. It is the database which is shared by the entire network (Swan, 2015). Once a transaction is recorded into the ledger, it can't be altered, which is achieved through cryptographic algorithms. When the transaction is committed to the ledger, it is spread to all other nodes in the network in a distributed, non-centralized fashion.

2.4.1.2 The Protocol

In the middle of the stack is the protocol. The protocol is the system that transfers the digital assets over the blockchain ledger. In the case of Bitcoin, this can be compared to the different wallet software solutions that handles the transfer of digital currencies.

2.4.1.3 The Currency

The top layer of the Bitcoin technology stack, is the Bitcoin currency itself, which is used as the currency in bitcoin transactions.

2.4.2 Components of Blockchain Technology

While there are many implementations of blockchain technology, they have similar elements in common. In the following subsections, the common building blocks that constitute a blockchain will be discussed.

2.4.2.1 The Block in the Chain

One of the most used definitions of blockchains, is by the comparison of an open, public ledger containing all the transactions made in the network.

A report made by the UK's Government Office of Science, defined a blockchain as such (Walport, 2016):

> "A block chain is a type of database that takes a number of records and puts them in a block (rather like collating them on to a single sheet of paper). Each block is then 'chained' to the next block, using a cryptographic signature. This allows block chains to be used like a **ledger**, which can be shared and corroborated by anyone with appropriate permissions." (Walport, 2016, p. 17)

By looking at Figure 3, we can see what a block in the chain contains. In this specific example, it is the Ethereum blockchain. Each block contains a timestamp, a nonce, the hash of the previous block, and a list of transactions that constitutes the block.

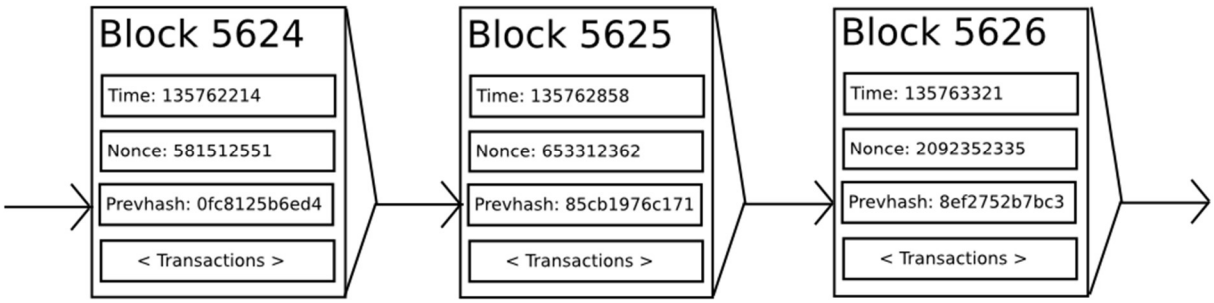


Figure 3 Blocks in the Chain (Buterin, 2014)

Each transaction is a representation of a transfer of a virtual asset. Many things can be defined as a virtual asset, i.e. a digital token can represent the ownership of a car or house. A more commonly known virtual asset is cryptocurrency, i.e. Bitcoin.

2.4.2.2 The Consensus Mechanism - the corroboration aspect of blockchain technology.

In the case of Bitcoin, the corroboration method used is consensus, in Bitcoin terms *mining*. Specifically, the *miners* in the Bitcoin network mines the blocks that are to be appended to the chain. Miners use a proof-of-work system, to claim which block is to be the next block added to the chain. Under the proof-of-work system, a block is a computationally hard to create, but easy to verify. To claim the next block, miners must produce a cryptographic hash (SHA-256) with several leading zero bits, which contains all the transactions to be included in the block, a nonce which is a random number, the hash of the previous block, and a timestamp. And since all the blocks are cryptographically linked together, to change a previous block, one

must also change all the subsequent blocks. This makes it very hard to change a transaction or a block, as it requires immense computational power (Nakamoto, 2008).

2.4.2.3 Smart Contracts

The term "Smart Contract" was first coined by Nick Szabo (Wikipedia, 2016). A smart contract is the idea of embedding contracts into hardware and software (Szabo, 1997). An example of a smart contract used by Szabo, is the vending machine. The vending machine accepts coins, and through an internal mechanism validates and provides the user of the vending machine with an output, i.e. a soda, coffee, sandwich etc. (Szabo, 1997).

Smart contracts are pieces of code that run autonomously when called upon (Buterin, 2014). More specifically, the smart contracts can have programmable rules embedded in them, and based upon the input they get, they will produce a certain output. A simple example is an escrow contract: 3 parties put up some amount of cryptocurrency into a smart contract, functioning as the escrow. For the money to be used, it requires 2 of the 3 signatures of the users to allow the usage of funds (Buterin, 2014).

2.4.3 Various Implementations of Blockchain

While there are many different blockchain solutions, this thesis will briefly highlight the following blockchain implementations.

2.4.3.1 Bitcoin

The Bitcoin blockchain is solely used for the cryptocurrency Bitcoin. While it is possible to embed data onto the blockchain's transactions, its main purpose is to facilitate financial transactions. Every transaction can be accompanied with a fee. This fee serves as an incentive towards the miners of the network to priorities their transactions. This is optional, but encouraged.

The miners in the bitcoin network serve as the validators in Bitcoin's consensus mechanism.

2.4.3.2 Ethereum

Ethereum has been advertised as an open computer spanning its entire network. The Ethereum blockchain is a "Turing-complete" blockchain. This mean that the blockchain can be programmed to do "anything".

Ethereum uses its own cryptocurrency called "Ether". Ether is used both as currency and as the fuel that powers the network. In this network, every action and transaction cost "Gas", paid by with Ether. This is like Bitcoin's fees associated with transactions.

2.4.3.3 Hyperledger

The Hyperledger project is a consortium of different industries that work together, led by the Linux Foundation, to create an open source blockchain solution. One of the interesting points about Hyperledger, is that it is a "pluggable architecture" (Hyperledger Project - The Linux Foundation, 2016). This blockchain solution does use a one-size-fits-all approach, but allows the participants of any Hyperledger blockchain to customize how their blockchain functions.

One interesting part of Hyperledger is that there is no one specific consensus mechanism; participants of the specific chain can specify how consensus is achieved within the specific blockchain.

Another interesting part of Hyperledger, is the design choice that not everyone needs to hold all the data. Since Hyperledger is classed as a permissioned blockchain, it allows for confidentiality between partners on the blockchain, i.e., some data is only accessible by certain actors on the blockchain. For example, in theory, a radish farm in Peru can sell radishes to a fruit store in San Francisco at a below normal price through a smart contract, but only those two actors know of the special price. This does not only apply to smart contracts. During the transaction of goods between the farm and the store, only they get a copy of the data regarding the products journey from farm to store. While the travel of the products can be public, the price of the products is confidential, only available to the farm and store (IBM, 2016).

A comparison of the mentioned Blockchain technologies can be seen below. Note, that there are many Blockchain technologies being developed, but I have only chosen to highlight three.

Blockchain	Immutable data	Business logic	Mutable Data
Bitcoin	Blocks of transactions	Smart Contracts	-
Ethereum	Blocks of transactions	Smart Contracts	Smart Contract Data Storage
Hyperledger	Blocks of transactions	Chaincode	Blockchain Database, i.e. CouchDB or other implemtentations

Table 2 Comparison of Blockchain Technologies (Source: own creation)

2.4.4 Applications of Blockchain Technology

While Blockchain technology is a fascinating new technology, there has been no mention of widely-used applications of this new technology, outside of cryptocurrency. According to Swan, there are many interesting areas where blockchain technology can be utilized, including healthcare, banking, supply chain, research and science, and government (Swan, 2015).

3 Methodology

3.1 Case Study Research Approach

This thesis utilized a multiple-case study approach (Yin, 2014). Instead of focusing on a phenomenon at a single organization, I will attempt to research the same phenomena at multiple organizations.

3.1.1 Unit of Analysis

To focus the research, I will here define the units of analysis (Yin, 2014). The unit of analysis – or the "case" – need to be defined with regards to the research question. Otherwise, the study could cover all aspects about a phenomenon, which in this thesis would be impossible.

With the research question as a guide, the units of analysis of this study can be narrowed down to the following phenomena:

(1) **The elements of information disclosure**. To further narrow the case, the elements in this regard, are considered the ways in which supply chain members and relevant regulatory entities share information and utilize the shared information.
(2) **The technology of information disclosure.** To make it more specific, technology is focused on the 'how' information is shared and utilized.

These two units combined with the operationalization (see 3.3 Operationalization), a more precise guide of data collection for the case study emerges.

3.1.2 Case Study Protocol

As a supportive tool, a case study protocol was used during the research process. This protocol is also used to increase the reliability of the case study (Yin, 2014). The protocol serves as a guide for the researcher when doing fieldwork. The researcher uses the protocol as a rulebook for how the researcher should gather data, and how interviews should be conducted and what questions the research needs answers to.

During interviews, the case study protocol lists the questions that the researcher need to answer, i.e., the level 2 type questions posed to the researcher, but the researcher must find these answers by posing level 1 type questions to the key person(s) while in the field (Yin, 2014).

The case study protocol is usually comprised of four major sections: an overview of the case study, data collection procedures, data collection questions, and a guide for the case study report (Yin, 2014).

An example of the case study protocol used can be seen in appendix 9.1.

3.2 Use of theory

In this section, I will describe the how the theory in the literature review will be used, and how it will not be used.

3.2.1 Supply Chain

The literature on supply chain and supply chain management is used in this thesis to increase the author's understanding of the supply chain situation of the pharmaceutical industry.

3.2.2 Transparency

As described in the literature review, transparency is a widely-covered area. In this thesis, the working definition as transparency will be focused on the disclosure of information on the managerial and regulatory level. Disclosure of information regarding sustainability or information aimed for public disclosure will not be considered in this thesis.

3.2.3 Blockchain

Literature regarding blockchain technology is used in the analysis, specifically in conjunction with the design of the reference architecture. It will also be used to ascertain the viability and fit of the functionalities of blockchain technologies in pharmaceutical settings.

3.3 Operationalization

The operationalization process is designed to break the research question down to smaller variables. Through this step, the operationalization process provides us with the variables that we need to provide answers for, to answer our research question (Harboe, 2009).

The operationalization method used in this paper is the same as the one described by Thomas Harboe (Harboe, 2009). This method is used to define the variables in which facts are gathering during the research process. The variables used are defined from the research question through the nominal definition. The nominal definition is a process in which the research questions is made more articulate, specifying the scope of the research question. From the nominal definition, the variables used to answer the research questions are defined. These variables will guide the research, ultimately answering the research question.

3.3.1 Research Question

The research question for this paper is:

> How can blockchain technology be used (or leveraged) to provide transparency in supply chains of material goods?

3.3.2 Nominal Definitions

The nominal definitions are as follows:

1. By transparency, it is referred to the action of disclosing information to either supply chain partners or any regulatory entities. As described in section 3.2.2, the focus will be on management transparency and regulatory transparency.
2. With an understanding of supply chains and how they are managed and how information is shared between the supply chain partners (see 2.1), the current state of the supply chain in the pharmaceutical industry is analyzed. To measure the current state, comparisons will be made to the literature.
3. Based on the literature review and the data gathered, comparisons will be made to the current and future practices in general to the functionalities of blockchain technology and propose ways in which blockchain technology can used to provide transparency of supply chains. Future practices in this case means the proposed practices defined in the Falsified Medicine Directive.

3.3.3 Operational Definition

By extracting from the nominal definitions, we have ended up with 3 units, each differentiated into their respective variables. The units are as follows:

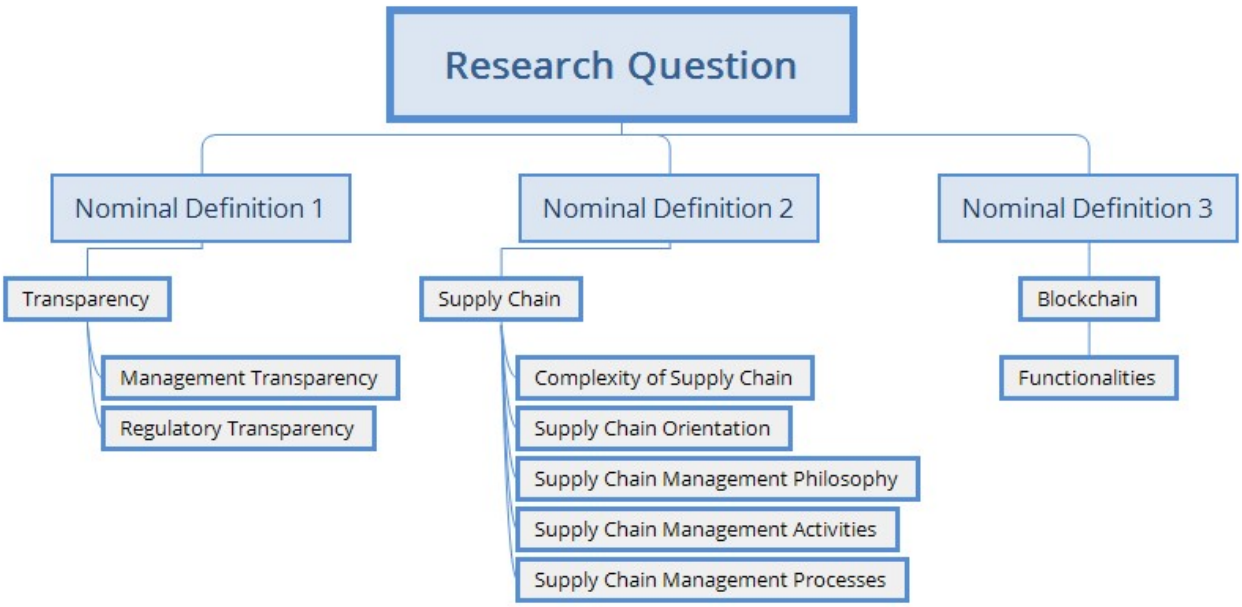


Figure 4 Operationalization chart (Source: own creation)

3.4 Secondary Data

The secondary data plays a big role in this thesis. The concepts learned through the literature review, will be used as guidelines to narrow focus on the research, also known as the study propositions (Yin, 2014). The study propositions help directing the attention of the researcher towards something that should be examined within the scope of the case study (Yin, 2014, p. 30).

Since the focus is on transparency, the concepts presented in the literature review help shape the questions posed during the primary data collection. The same can be said regarding how the supply chain is managed and information is shared. This can be seen in the case study protocol.

Other documents and articles can also be used to confirm or deny the concepts that are listed in the literature review. These documents can come in the form of e-mails, corporate documents, internal reports, formal studies, and news articles to name a few (Yin, 2014).

3.5 Primary data

The primary collected is used to show the perspectives held by the members of the pharmaceutical supply chain. Each firm has their core business functions and goals, and as such the view on what transparency entails can differ. The primary data is therefore intended to paint a picture, showing the opinions held by different participants of the pharmaceutical supply chain.

To obtain data within the pharmaceutical industry, I contacted the different firms within the pharmaceutical supply chain. A state pharmacy in the Faroe Islands. An IT service and hardware provider, operating in the pharmaceutical supply chain. A pharmaceutical wholesaler. The only link missing is a manufacturer of pharmaceutical products.

3.5.1 Interviews

As a method of gathering data, interviews were conducted with relevant persons in throughout the pharmaceutical supply chain. Some interviews were done over the phone (3 phone interviews) and others were done in person (2 interview). In both cases, the interviews are recorded, leaving the interviewer free to fully engage in the conversation with the interviewee(s).

3.5.1.1 Interview Structure

The interviews are shorter case study interviews (Yin, 2014). These interviews are more focused, often with specific questions that are carefully worded (Yin, 2014). However, liberties were taken when deemed necessary and some questions were explored more freely, depending on the points made by the interviewee.

During the research stage of this paper, two versions of interviews were performed: phone interviews and focused interviews (Harboe, 2009) (Yin, 2014).

The focused interviews are done in person. These allow for more in-depth and semi-structured interviews. These interviews also allow the interviewee to "go on tangents" that could prove to be relevant later in some regards. A Case Study Protocol (Yin, 2014) is used during these interviews as a guide for the interviewer.

The phone interviews were chosen for interview that usually took less than 30 minutes. These interviews weren't as in-depth as the focused interviews. Some benefits of using phone interview are that they are fast, easy and cheap to perform for both parties.

3.6 Analysis Structure

The first part of the analysis will describe the current practices, view on transparency, and supply chain orientation within the pharmaceutical supply chain. The focus will be from the pharmacy's point-of-view, with some insight of how wholesaler interact with the pharmacy. Second, a comparison between the practices, and transparency and supply chain literature will be made. Finally, the supply chain practices will be compared to a proposal of a suggested version of practices that incorporates Blockchain technology. There will not be a focus on a specific Blockchain technology, however distinctions will be made when necessary.

4 Data Gathered

This chapter focuses on documenting the data and insights learned from the data gathering process, both from secondary sources and from primary data gathering.

The first section will describe which regulations and standards are used in the pharmaceutical industry. A description of the guidelines on Good Distribution Practice of medicinal products is presented, followed by a brief description of the Falsified Medicine Directive. After this, a summary of the standards set by the organization GS1, GS1 barcodes and EPCIS, is presented. It is important to understand that these elements have a big effect on the procedures used within the pharmaceutical supply chain processes, and ultimately in the reference design. The last sections will cover the insights gleaned from interviews with members of the pharmaceutical supply chain.

4.1 The Pharmaceutical Industry

4.1.1 Good Distribution Practice (GDP)

In the pharmaceutical industry, organizations are required to follow Good Distribution Practices to ensure the quality and management of medicinal products. The GDP is a set of guidelines that regulates the activities covering the procurement, holding, supplying and exporting of medicinal products (European Commision, 2013). While the GDP cover almost every aspect regarding the life cycle of the medicinal product, this thesis will focus on the rules regarding documentation of medicinal products.

Part of the GDP states that sellers of medicinal products must have an effective quality control system implemented, and documentation must be provided describing responsibilities, work practices and risk-management measures. The GDP also states that sufficient room must be available for medicinal products that is marked for decommission or suspected of being counterfeit (European Commision, 2013).

Per the GDP (European Commision, 2013), wholesalers and pharmacies must ensure that medicinal products are only purchased from entities who are certified to produce or sell medicinal products. Wholesalers and pharmacies must also store documentation regarding all shipments received, which must include (European Commision, 2013):

1. the date of delivery/receival
2. precise identification of the product name
3. delivered amount
4. the pharmaceutical form
5. strength and package size
6. receiver's name and address
7. deliverers name and address
8. batch number

4.1.2 The Falsified Medicine Directive

The Falsified Medicine Directive (European Commision, 2016) is a guideline on how the central registration system of verified units of medicinal products should function. This guideline proposes that a top-level centralized system holding all the data for the entire EU is established and controlled by a relevant non-profit legal entity, with mid-level systems for each member state is established and controlled by relevant non-profit legal entities. Each of the non-profit legal entities must be set up by the manufacturers or marketing authorization holders of the medicinal products (European Commision, 2016). The top-level system then serves as a hub for all the mid-level systems in each country. This way, medicinal products produced in country A are registered in their local mid-level system, and then communicated via the top-level system to the mid-level system in Country B, where the medicinal products are consumed.

The primary function of this directive is to suggest a system that will make it difficult for falsified medicinal products to enter the legal supply chain. To accomplish this, the Falsified Medicine Directive suggests the implementation of two new features to current practices: A unique identifier on each unit where the authenticity and identity can be verified, and an anti-tampering device present on each unit (European Commision, 2016).

4.1.2.1 Anti-tampering Device

The anti-tampering device serves as the physical attempt to prevent falsification or tampering of legal medicinal products. Each unit can be physically inspected to verify the integrity and authenticity of the product. After the physical inspection, the product can then be verified digitally using its unique identifier.

4.1.2.2 Unique Identifier

The addition of a unique identifier represents the digital attempt to prevent falsification of legal medicinal products. Each unit is registered by the manufacturer or market-authorization holder in the mid-level system as being genuine, and this information is the propagated to the other mid-level system, via the top-level system, when required. By looking up the unique identifier, the state of each unit can be authenticated throughout the EU.

Per the Falsified Medicine Directive, the unique identifier must contain these data elements in a 2D-barcode present on the package on the medicinal product, which results in a numeric or alphanumeric sequence of characters that can be parsed by a IT-system using a 2D-barcode scanner (European Commision, 2016):

- A code that allows the identification of at least the name, the common name, the pharmaceutical name, the strength, the pack size and the pack type of the medicinal product, i.e. the product code
- A random numeric or alphanumeric sequence of maximum 20 characters, i.e. a serial number
- A national reimbursement number or other national number allowing for the identification of the medicinal product
- The batch number
- The expiration date

In addition, the same data elements must also be present in human readable form on the package of the medicinal product.

It is the manufacturers' or the market-authorization holders' responsibility to upload the unique identifier of their products to their national system, when the medicinal product enters the market. While the product exists in the supply chain, the supply chain actors can check the authenticity of the product through their respective national system. When the product is sold to the public by the pharmacy, it is the pharmacy's responsibility to register the specific medicinal product as sold or decommissioned via it's unique identifier (European Commision, 2016).

4.1.2.3 The digital states of a medicinal product

Each medicinal product can digitally exist in 2 states: Active and Decommissioned (European Commision, 2016).

While in the Active state, the medicinal product can be distributed and sold to the public.

A medicinal product is put in the Decommissioned state, when the product is sold to the public, distributed outside the EU, expired or slated for destruction. Products registered as Decommissioned should not be further distributed or be sold to the public.

It is possible to revert the status of Decommissioned to Active, however strict rules apply (European Commision, 2016, pp. 10-11).

4.1.2.4 Design of the proposed digital system

The system proposed in the Falsified Medicine Directive is based on a Spokes-and-Hub design. The main advantage of such a system lies in the ease of which new "spokes" can be added. However, the main disadvantage of such a design, is the possibility of a central point-of-failure at the "hub" (Wikipedia, 2017).

A low-fidelity model of the proposed system can be seen in Figure 5.

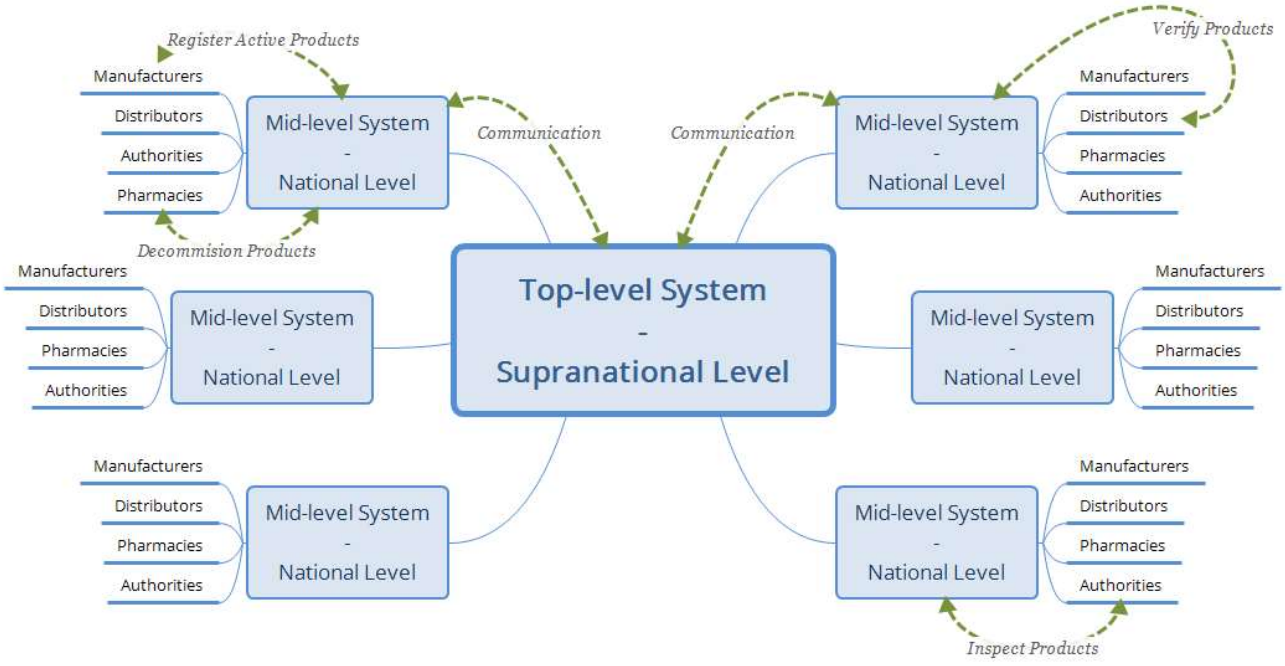


Figure 5 Proposed Design by the EU in the Falsified Medicine Directive. (Source: own creation)

4.2 GS1 and EPCIS

4.2.1 GS1

GS1 is a known standards organization regarding serializations, transaction data and barcodes for use in supply chains (GS1, n.d.). Almost all products sold in the world has a barcode printed of the packaging, including medicinal products. The foundation of the GS1 system is identification through barcodes (GS1, 2017). When working with GS1 standards, there are several identification standards, such as GTIN, GLN and SSCC.

4.2.1.1 GTIN – Global Trade Item Number

GTINs are numeric strings of characters. They come in 4 different varieties: GTIN-8, GTIN-12, GTIN-13, and GTIN-14. A GTIN is used to identify items that are traded and produced in a homogenous fashion, i.e. same version and composition (GS1, 2017).

4.2.1.2 GLN – Global Location Number

GLNs are used as a unique and unambiguous identifier of (GS1, 2017):

1. Physical locations
    a. A site, area, structure or group of structures.
2. Digital locations
    a. A digital representation of an electronic address used for communications between computer systems.
3. Legal entities
    a. Any business, government body, department, charity, individual or institution that has standing in the eyes of the law and has the capacity to enter into agreements or contracts.
4. Functions
    a. An organizational subdivision or department based on the specific tasks being performed, as defined by the organization.

4.2.1.3 SSCC – Serial Shipping Container Code

SSCCs are used for the identification of logistic units, i.e. a pallet of goods (GS1, 2017).

The previous 3 GS1 codes are physically represented by barcodes. There are two varieties of barcodes: linear symbols, and two-dimensional symbols (GS1, 2017).

4.2.2 EPCIS

In the field of logistical track-and-trace and ensuring data interoperability, GS1 has developed the EPC Information Services (EPCIS) standard. This standard enables users to gain a shared view of physical and digital objects within a relevant business context, i.e. where a product is and why at any given time (GS1, 2016).

	Retrospective (at the time of the event)	**Prospective (true until contradicted by subsequent event)**
What	EPC EPCClass + quantity	
When	Time	
Where	ReadPointID	BusinessLocationID
Why (business context)	BusinessStepID	DispositionID
	BusinessTransactionList Source/Destination ILMD	

Table 3 Summary of the fields of the event type that pertain to the four key dimensions (GS1, 2016)

The main goal of using EPCIS, is to provide visibility data among supply chain partners. Using EPCIS, details regarding the physical and digital activitiesof a medicinal product within the supply chain can be shared among supply chain partners (GS1, 2016).

4.3 Interview Sessions

This section will summarize the key points learned during the interviews with the different interviewees. The interviews are transcribed and are available in the appendix of this thesis (see 9.3).

4.3.1 Interview with Per Hansen, December 9th 2016

During the interview with Per Hansen, it became clear that the Falsified Medicine Directive only suggests an "end-to-end" system. The manufacturers enter their products into the system, signaling that the products are active on the market, while the pharmacies are to make sure that the products are marked as Decommissioned, i.e. sold to consumers, signaling that the products are now inactive on the market. Per Hansen suggests that this system could be enhanced by implemented a standard such as EPCIS, to further increase the visibility regarding the products on the market during their supply-chain-life-cycle (Hansen, 2016).

4.3.2 Interview with Steen Banke, December 9th and 13th 2016

From these interviews, a picture of the current supply chain landscape in Denmark was shaped. There are two major wholesalers who supply almost all pharmacies in Denmark. Also, pharmacies all use the same or similar IT-solutions in their organization, regarding inventory and product management, most supplied by NNIT. Each of the major wholesalers have their own paradigm as to how they manage their customers' inventories, but they both utilize the same electronic protocol called PharmaLink, developed by NNIT by request of the two wholesalers (Banke, 2016).

With regards to the Falsified Medicine Directive, there many challenges ahead. The Falsified Medicine Directive enforces the use of a 2D-barcode on each product unit. This in turn changes how the personnel and systems need to interact when handling the products. But this also provides many opportunities with regards to transparency, with the biggest opportunity being able to quickly identify batches of products that need to be recalled for any reason. Today, it is very difficult to identify locations where recalled products are placed within the supply chain. The biggest challenge today though, is deciding how such a solution should be developed and implemented (Banke, 2016).

The current norm within the pharmaceutical market in Denmark, is that a pharmacy buys all their medicinal products from a single wholesaler, making the pharmacy highly reliant on the wholesaler. Because of this, many have chosen to implement a Vendor Manage Inventory system, giving the wholesaler control over the inventory management and purchasing of products on behalf of the pharmacy.

4.3.3 Interview with Richard Schwartson and Allan Nolsøe, December 28th 2016

The biggest concern for the State pharmacy in Faroe Islands, is whether the future IT-solutions will alter current practices for the better or worse. They emphasize that the future IT-solution must be simple to use, regarding the practices demanded at pharmacies and sale of medicinal products. The IT-solution should be developed with automation in mind, but still manage the necessary documentation required behind the scenes (Nolsøe & Schwartson, 2016).

One of the challenges faced by the State pharmacy, is the handling of expired products. While they have a high-tech robot-managed inventory, their system can currently not identify when each product is expired because that information cannot be read by the robot. Instead, every six months for each product, the robot places the products in a bin for the staff to examine if the products are close to or have expired, and then manually enters this information into the system (Nolsøe & Schwartson, 2016). After the interview, I received permission to observe how the staff works with the robotic inventory system.

Figure 6 Photo of the robotic inventory system at Tjaldurs Apotek in Tórshavn, Faroe Islands (Apoteksverk Føroya, n.d.)

4.3.3.1 Observations at Tjaldurs Apotek

While observing how the staff worked with the robots, I learned that while the system made it easier to handle prescription medicine, there was one major drawback to the system. The robot could not read the expiration date on the package of the medicinal product. While the robot could easily read barcodes, is could not reliably read the expiration date, which was written in human language. Therefore, the system was set up to automatically set the expiration date to 6 months after the product was registered into the inventory. Then every 6 months, the staff would manually check if the products pulled out by the robot because of expired products, could last another 6 months, and then reentered into the inventory. There was however excitement for the new 2D-barcodes that had been proposed in the Falsified Medicine Directive, since the robot could then read the expiration date itself, and handle the products accordingly.

4.3.4 Interview with Elin Mouritsen, December 30th 2016

From this interview, it was learned that the Good Distribution Practices guidelines and ISO guidelines heavily influence the practices at any pharmacy, where the Good Distribution Practices are required by law. It is also required that pharmacies routinely verify that their trade partners have the correct and valid certification to sell and distribute medicinal products. Pharmacies practically have guidelines for every action that must be taken within the organization regarding how medicinal products are stored, transported, handled and sold, guided by the Good Distribution Practices guidelines. And everything must be documented (Mouritsen, 2016).

It is also mention throughout the interview that there is a great deal of trust implied when working with their supplier. There is an implicit trust that products purchased from the supplier is genuine and that any suspicions regarding the products is handled by the wholesalers. Because of this trust, the pharmacy only focuses on their immediate supplier and immediate customer. Currently, all shipping is managed by the supplier, except for the logistics between the final distribution point and the pharmacies warehouse (Mouritsen, 2016).

5 Analysis

5.1 Part 1: Supply Chain

The interview with Elin Mouritsen (see 4.3.4) suggests that most pharmacies work from a first degree of supply chain channel relationship, a Direct Supply Chain (see Figure 1), but are aware that the wholesaler work from a Ultimate Supply Chain mentality (see Figure 1). From the statements by Elin Mouritsen, the wholesaler cover most of the key supply chain processes (see 2.1.4.6), making it so that pharmacies can focus on serving their customers.

From the interview with Steen Banke (see 4.3.2) we have confirmed that pharmacies in Denmark have a highly integrated behavior (see 2.1.2.1) with regards to their purchasing practices. Most pharmacies in Denmark utilize a Vendor Managed Inventory approach, leaving the wholesaler in charge of what medicinal products the pharmacy keeps in stock, which implies a high level of trust (see 2.1.4.1) and interdependence (see 2.1.4.3) between the pharmacy and the wholesaler. By using a Vendor Managed Inventory approach, it also implies a high degree of sharing information (see 2.1.2.2), cooperation (see 2.1.2.4), and integration of processes (see 2.1.2.6).

5.2 Part 2: Transparency

As learned from the interview from Steen Banke (see 4.3.2), most pharmacies use Vendor Managed Inventories. In this case, Vendor Managed Inventory relies on the pharmacy's inventory and sales figure (Nomeco A/S, n.d.), meaning that the pharmacy must disclose information to their wholesaler (see 2.2.1.1), and to improve the effect of the disclosure, the pharmacy must disclose accurate information (see 2.2.1.3).

From the interview with Elin Mouritsen (see 4.3.4), the pharmaceutical industry operates in a highly-regulated field. Of particular interest, is the amount of documentation required, which can be viewed as a form of regulatory transparency (see 2.2.2.2), and also the quality control system requires work processes to be documented, a form of management transparency (see 2.2.2.1).

Per Hansen mentioned in his interview (see 4.3.1) that there is a great demand for event data throughout the supply chain. He suggested that the implementation of EPCIS or similar standard, could improve the level of transparency within the supply chain. In this case, he is referring to management transparency (see 2.2.2.1), as he is mostly interested in the disclosure of information that has value in a logistic and management sense.

5.3 Part 3: Blockchain

This section will suggest simple designs which includes the requirement set by the Falsified Medicine Directive, Good Distribution Practices, and GS1 Standards including EPCIS. First, a system covering the requirements of the Falsified Medicine Directive will be presented, followed by a system covering the documentation requirements of the Good Distribution Practices guidelines, which is later modified to include GS1 standards. Last, a system based on the EPCIS standards using Blockchain technology is presented.

5.3.1 Blockchain: Falsified Medicine Directive Requirements

First, the main requirement set by the Falsified Medicine Directive, with regards to the system that is to be put in place to handle the unique identifiers will be listed.

A manufacturer uploads the unique identifier to the national system with an Active state, after which the data can propagate to other national systems through a central, supranational hub when other actors within the supply chain attempt to lookup the unique identifier of the product. After the product is sold, the pharmacy changes the state of the product to Decommissioned, signifying that any product authenticated within the supply chain with this unique identifier, is most likely counterfeit. This system is based on a traditional centralized system design.

By using Blockchain technology, the unique identifier can be added to the Blockchain ledger through the manufacturer's local node, with no need of connecting a national system. When the consensus mechanism of the Blockchain technology used decides to append the information to the ledger, the information is spread to all other peers in the Blockchain network, without any need for centralization. However, this relies heavily on the consensus mechanism and ledger storage format being tailored for the registering of state of the unique identifier of a medicinal product.

An important note is that the consensus mechanism is, in conjunction with smart contracts, what upholds the standards set by the Falsified Medicine Directive. Only authorized actors within the supply chain can change the state of the unique identifier. Therefore, the Blockchain must be able to identify the legal entity that is attempting to change the state of a given unique identifier.

When a unique identifier is added to the Blockchain ledger, it is done so through a transaction. Each transaction must lead to the resolution of at minimum the following information: (1) the unique identifier of the product, and (2) the state of the unique identifier.

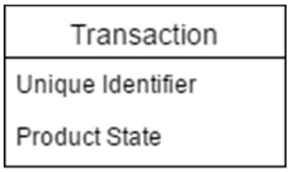


Figure 7 A single transaction (Source: own creation)

Figure 7 shows a model of how information can be stored on the Blockchain. The top section labeled **Transaction** represents the immutable transaction that is stored in the chain, while the bottom section represents the mutable data that is controlled by the business logic in the chain, for example a product can be represented as a virtual non-divisible asset. A single transaction is not restricted to only hold information about one single product, but can contain multiple products, like a Bitcoin transaction having different inputs and outputs. Figure 8 displays how a transaction chain represents a change of information of a single product. The transaction chain starts with the manufacturer uploading the unique identifier of a product. Then the product is sold to their customer, the wholesaler, which in turn sells the product to a pharmacy. When the pharmacy sells the product to the public, the pharmacy changes the state of the product's unique identifier to Decommissioned.

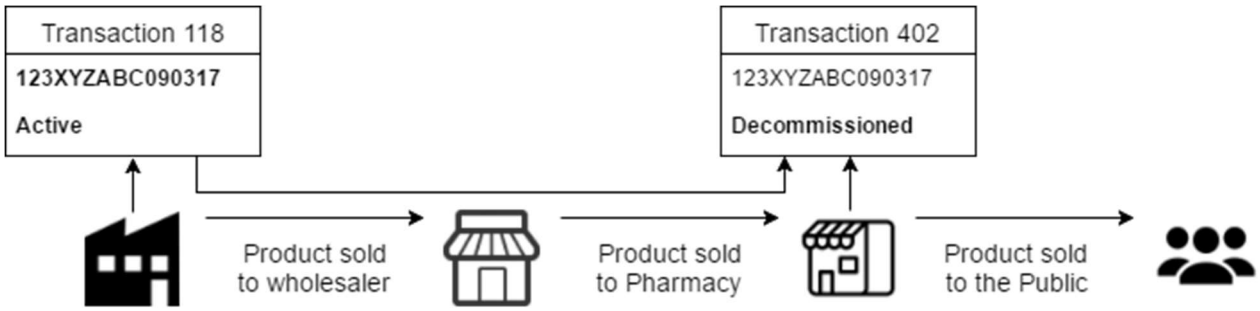


Figure 8 Transaction chain for a single product (Source: own creation)

Who has the authority to change the mutable information is determined by the business logic embedded in the Blockchain, either in the form of Smart Contracts or Chaincode (see 2.4.2.3). A simple example is this: Only manufacturers may add new products to the Blockchain, while only the pharmacies may decommission them. Of course, there can be exception to these rules, such as a product that has expired while in the wholesaler's care, giving them the authority to decommission the product based on that fact. Or if the wholesaler suspects that the product has been tampered with or counterfeited, they can notify the national authorities, which in turn can allow them to change the state of the product, if the product proves to have been tampered with or to be counterfeited.

The added benefit of the transaction chain, is that is provides the provenance of the medicinal product, using only the mandatory information required by the Falsified Medicine Directive, linked with the digital

signature contained in the transaction. However, with this setup, the Blockchain can only register two supply chain members, the manufacturer and the pharmacy.

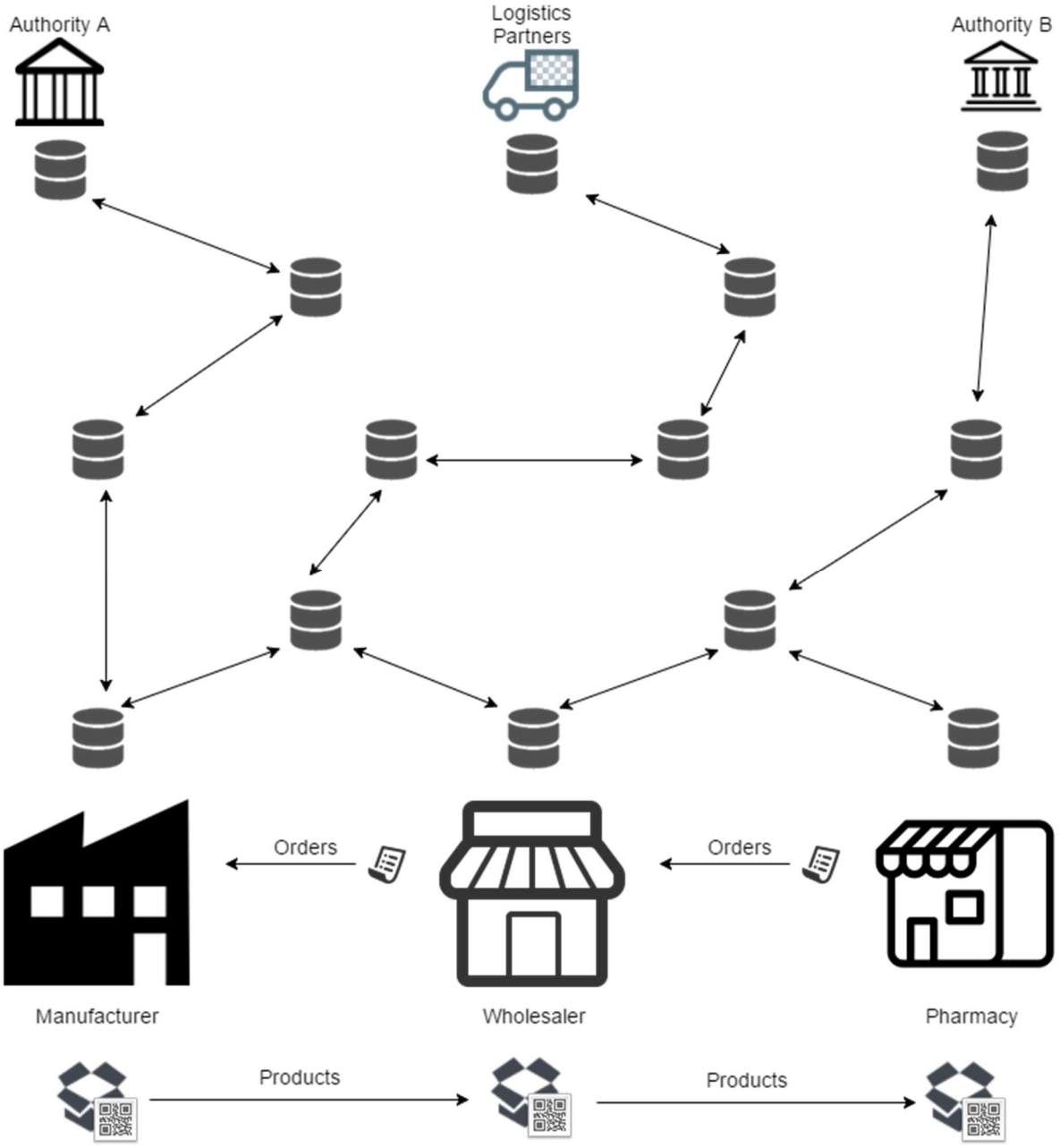


Figure 9 Data is broadcasted through a distributed network (Source: own creation)

As shown in Figure 9, information is not sent to the participants of the system through a central hub, but it is broadcast to all participants in the network in a peer-2-peer fashion. Because of the consensus mechanisms in place, the participant can trust the data being transferred throughout the network. By utilizing the 2D-barcodes, local systems at each organization can easily authenticate each product that enters their warehouse.

With either the Blockchain based system or the centralized system, the addition of the 2D-barcode allows the organizations to automatically check if a product that is received is counterfeit (see Figure 10). This enables the supply chain partners to be proactive with regards to counterfeited medicinal products. As soon as a warehouse worker (or robot, see 4.3.3.1) scans a 2D-barcode upon receiving the products, their local system can automatically check the repository to verify the authenticity of the products. Should the products be suspected of being counterfeit, the warehouse worker can immediately remove the products from stock, and handle the suspected products per GDP practices.

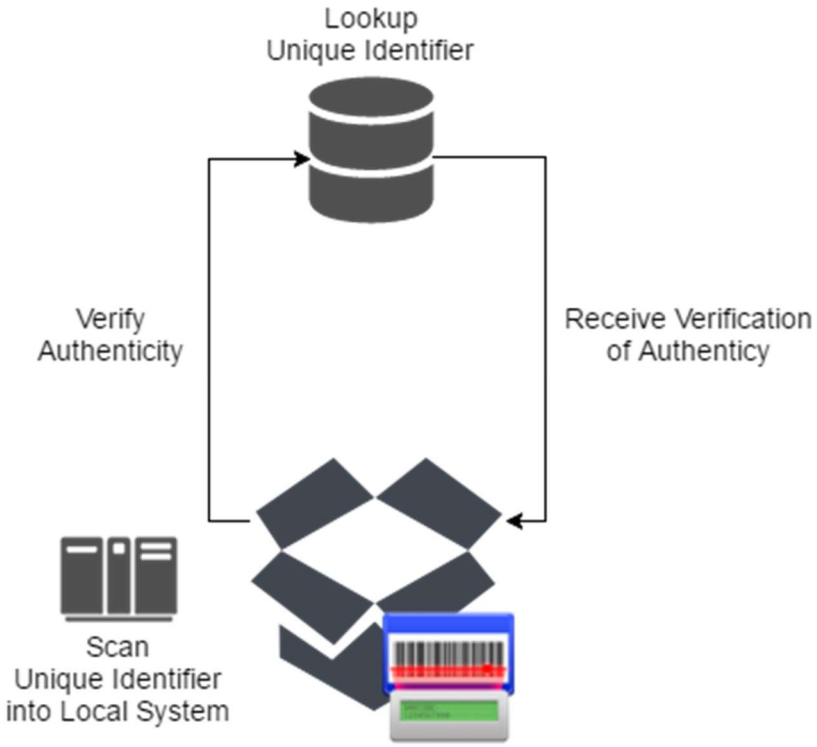


Figure 10 Simplified process with scanning 2D-barcodes (Source: own creation)

The intention of this Blockchain system is to provide the regulatory transparency (see 2.2.2.2) required in the supply chain.

5.3.2 Blockchain: Good Distribution Requirements

This section will include some requirements set by the Good Distribution Practices chapter 4 (European Commision, 2013, p. 6) (see also 4.1.1) into a Blockchain system, regarding documentation.

Assuming that the previous Blockchain system (see 5.3.1) uses its own ledger, and is not included into the ledger of this system, but has the capabilities to interact with other Blockchain systems. This includes the assumption that this Blockchain system can interact with other Blockchain systems. It is also assumed that requirements stated in the Falsified Medicine Directive are in effect.

At the beginning of a medicinal product's life-cycle, the manufacturer produces and registers the product onto the Blockchain. This can result in a transaction containing the following information (see Figure 11).

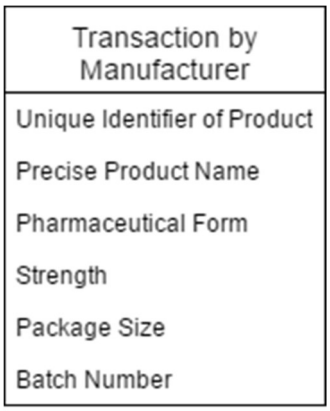


Figure 11 Unit-level transaction (Source: own creation)

This transaction serves as a record of information required by the GDP on a medicinal product at unit level. The unique identifier will help in tracking each product unit through the supply chain. It could be argued if the precise product name should be included because of the unique identifier, but for now, let's include it since it could help make the transaction more human readable.

When the product has been produced, it is put in a package, which becomes part of a larger delivery of packages. After a package is ready to be shipped, the manufacturer registers a transaction which contains the package number, a list of the packaged products.

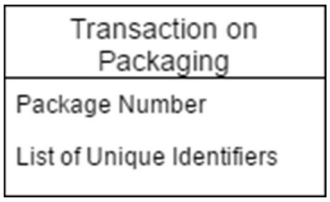


Figure 12 Package-level transaction (Source: own creation)

After several packages are ready for shipment, they are made part of a delivery. Again, the manufacturer registers another transaction which includes the packages in this delivery. However, date of receival is registered by the receiving supply chain partner (see Figure 13).

Figure 13 Delivery-level transaction (Source: own creation)

While the transactions are registered onto the Blockchain on their own, it is possible to trace the products included in every transaction.

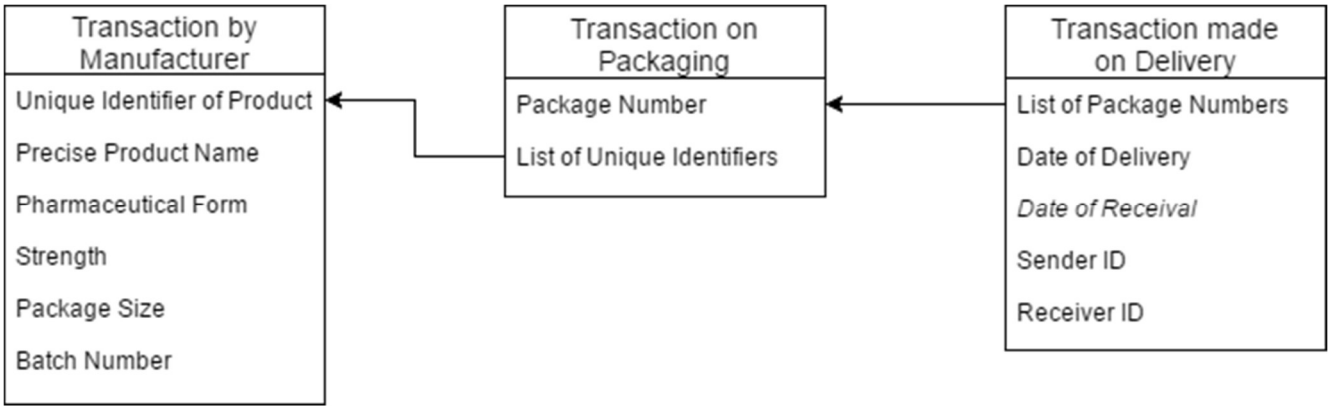


Figure 14 Transaction chain for a delivery (Source: own creation)

With this Blockchain system in place, it is possible for all relevant supply chain partners to inspect and validate the electronic documentation required. This example, however, does not consider the prerequisite authorizations and documentation from national authorities, which is required in most countries and varies from country to country. This system only focuses on the documentations required between manufacturers, wholesalers and pharmacies. As learned from the interview with Elin Mouritsen (see 4.3.4), entities in the pharmaceutical supply chain must verify, if their trade partner has the necessary certificates to work within the pharmaceutical industry.

5.3.3 Blockchain: GS1 Standards

In the following section, the GS1 standards will be added to the previous Blockchain system, essentially augmenting it to follow widely used practices.

Instead of imposing new standards into the Blockchain system, it may be prudent to use already existing practices. To conform with the rules of GDP, we will instead use GS1 identifiers. Below is a comparison between the different transaction from the previous system and the augmented system.

Transaction by Manufacturer
Unique Identifier of Product
Precise Product Name
Pharmaceutical Form
Strength
Package Size
Batch Number

Transaction by Manufacturer
Unique Identifier of Product
GTIN
Pharmaceutical Form
Strength
Package Size
Batch Number

Figure 15 Difference between unit-level transactions (Source: own creation)

As seen above, the only change is between the precise product name and GTIN. While the GDP required the precise product name, the same information can be retrieved by using the GTIN in a separate lookup.

Transaction on Packaging
Package Number
List of Unique Identifiers

Transaction on Packaging
SSCC
Package Number
List of Unique Identifiers

Figure 16 Difference between package-level transactions (Source: own creation)

In package-level transactions, we include the SSCC number, that the package is a part of.

Transaction made on Delivery
List of Package Numbers
Date of Delivery
Date of Receival
Sender ID
Receiver ID

Transaction made on Delivery
SSCC
Date of Delivery
Date of Receival
Sender GLN
Receiver GLN

Figure 17 Difference between delivery-level transactions (Source: own creation)

As seen in Figure 17, we move from listing all the packages included in the delivery, and instead assign a SSCC to the delivery. Also, the arbitrary ID's for sender and receiver has been changed to the more precise GLN. The changed transaction chain can be seen below.

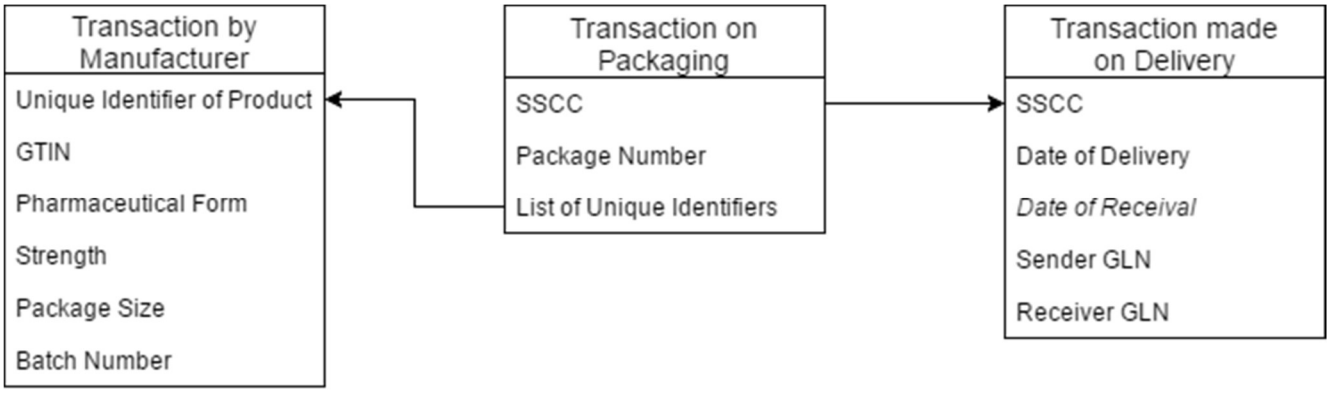


Figure 18 Delivery transaction chain including GS1 (Source: own creation)

5.3.4 Blockchain: EPCIS

The main aspect of ECPIS is the *what*, *when*, *where* and *why* states of a given product (see 4.2.2).

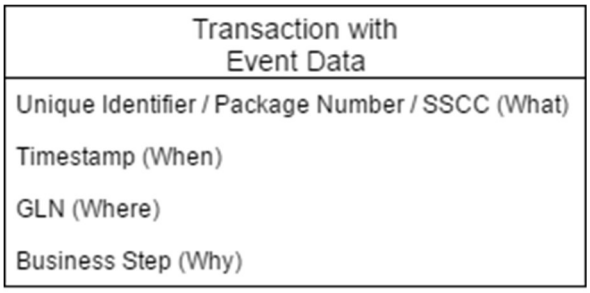


Figure 19 Transaction with EPCIS Event Data (Source: own creation)

As seen in Figure 19, a EPCIS transaction can include the products unique identifier, the package number or the SSCC. Here, the same data structure can be utilized, regardless is the event is at the unit-level, package-level or delivery-level. See Figure 20 for a simplified swimlane diagram, showing EPCIS transactions in the Blockchain system.

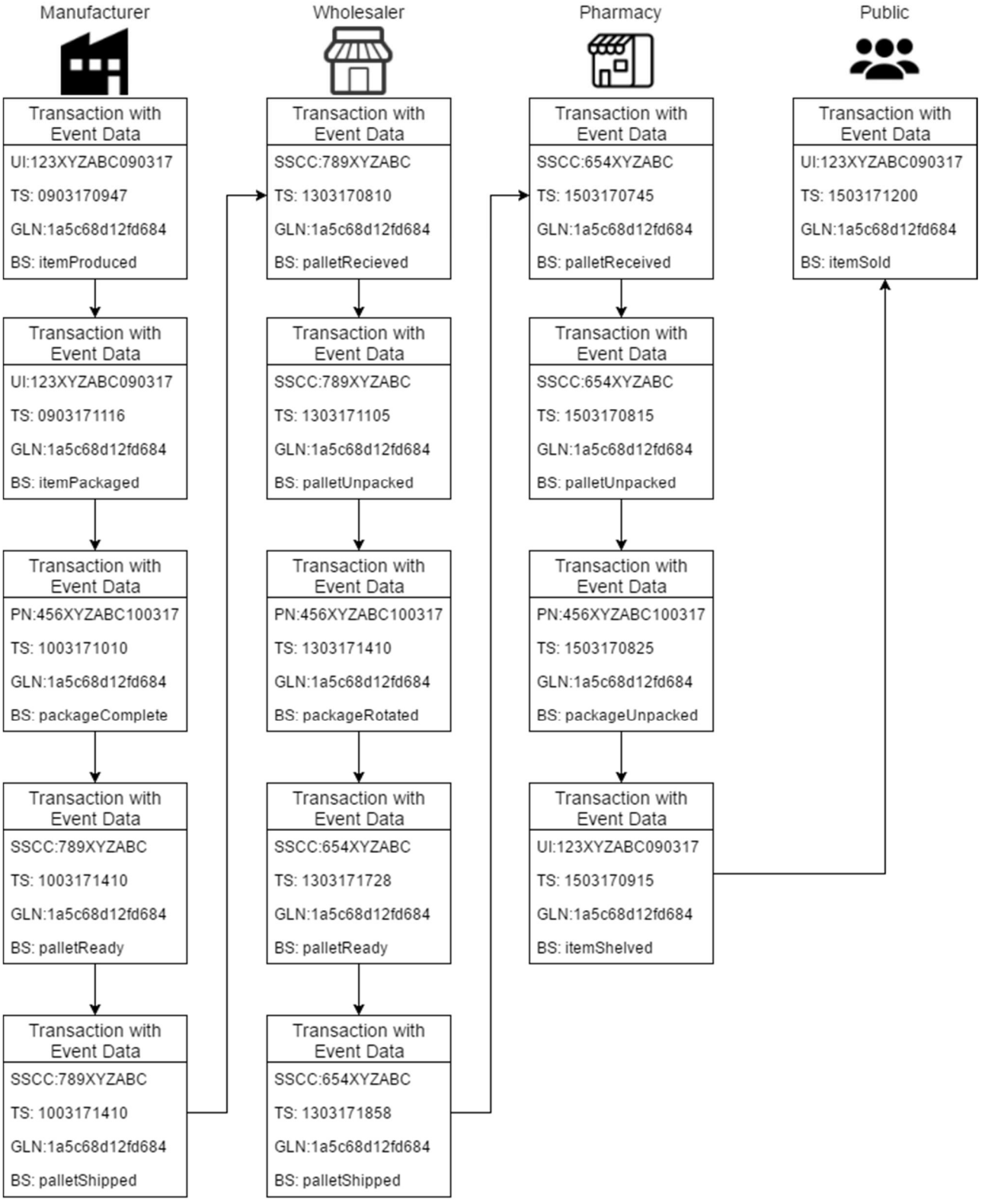


Figure 20 Simplified EPCIS swimlane diagram (Source: own creation)

The swimlane diagram in Figure 20 is very simplified with regards to the actual business step that occur within a medicinal products journey throughout the supply chain. The EPCIS standard is also much more

detailed than the transactions presented, but for the sake of simplicity, the transactions in this thesis are shown in their simplest forms.

Based on the interview with Per Hansen (see 4.3.1), there is a great demand on event data within the supply chain. By utilizing EPCIS, the pharmaceutical supply chain could achieve a higher level of transparency of the first 2 types mentioned in section 2.2.2 of this thesis. The firms in the supply chain achieve a greater management transparency (see 2.2.2.1), since they can follow how their products proliferate within the supply chain, possibly gaining new insights on how to improve the overall supply chain. National authorities can monitor if firms are upholding regulation (see 2.2.2.2) by looking at the information stored in the Blockchain ledger. This does however not replace the need for physical inspections when required.

An added benefit of using a Blockchain system like this, is that is discloses the membership of the supply chain (see 2.3.1), mapping out who a specific firm's trade partners are throughout the supply chain. It also discloses the provenance (see 2.3.2) of the medicinal product from manufacturer to pharmacy.

5.3.5 Blockchain Ecosystem

In the previous sections (from 5.3.1 to 5.3.4), 3 different Blockchain systems have been presented. Although they are simplified a great deal, they show the potential that Blockchain technology can be used in these areas. Furthermore, the assumption made before (see 5.3.2) regarding Blockchain systems interacting with each other, is made based on the review of emergent Blockchain technologies, such as Ethereum and Hyperledger. Based on this assumption, all 3 Blockchain systems can interact with one another within an ecosystem.

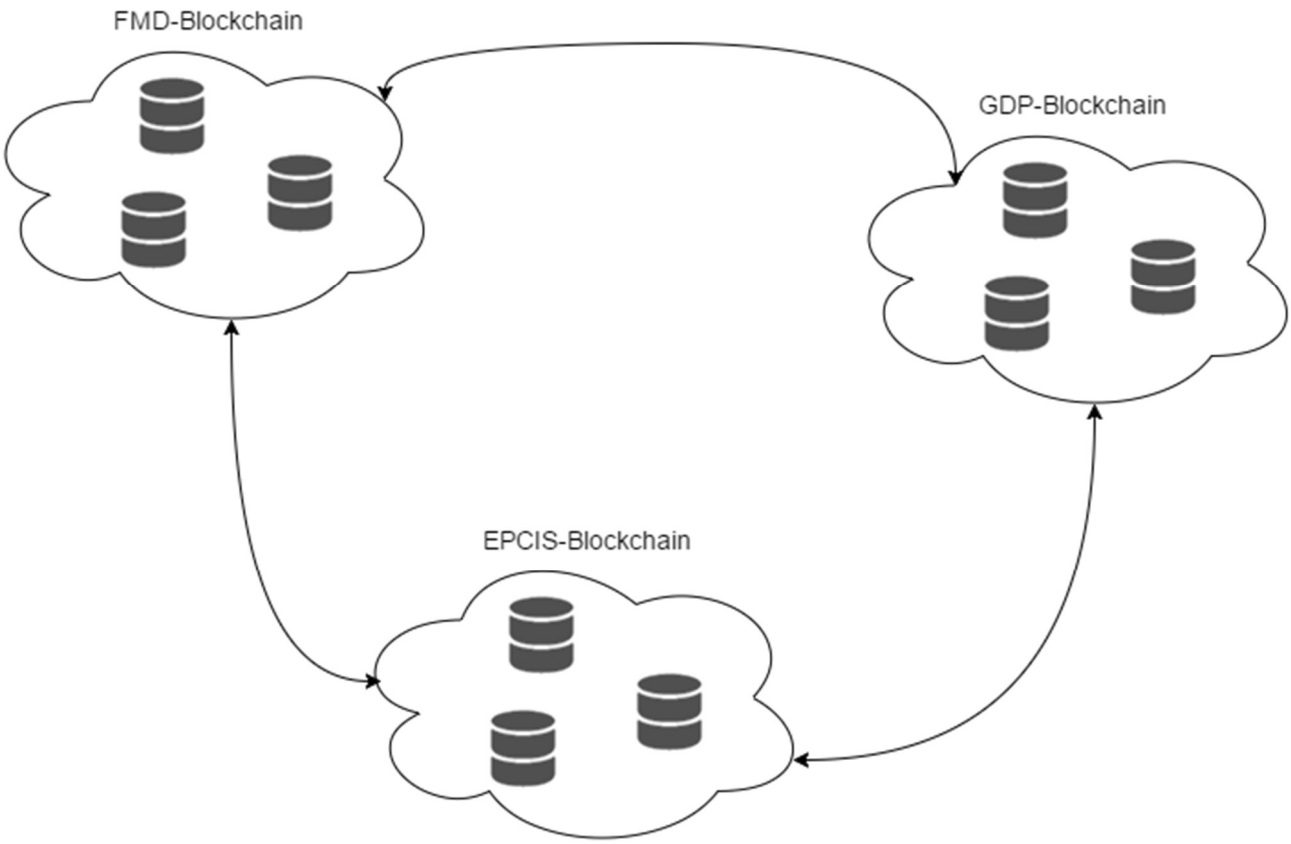


Figure 21 Blockchain system ecosystem (Source: own creation)

Because the Blockchain systems can interact, it is possible to setup smart contract that can check the authenticity of a medicinal products at every step during its journey through the supply chain. When a wholesaler scans the 2D-barcode to enter the product into storage, the EPCIS system and associated smart contract can look up the authenticity of the product by calling the smart contract in the FMD system. Should the product prove to be counterfeit, then the authorities can compare the information between the ECPIS system and the GDP system and search for discrepancies. Some of these functions could even be handled by smart contracts, minimizing the time spent on determining the counterfeit products entry point. How this can be accomplished, is not the objective of this thesis.

6 Discussion

While Blockchain technology is an exciting area of research, the technology itself is still in it's infancy. So far, the oldest implementation of Blockchain technology, Bitcoin, is only used on cryptocurrency. However, it does it remarkable well. It has proven that monetary transactions can work without a centralized institution. There is, however, many startups and projects in the world that attempt to implement Blockchain technology into their industry, such as banking, stock trading, deed management and many other areas.

While the Blockchain systems proposed in this thesis may work in theory within the pharmaceutical industry, putting it into practice is a whole other matter. It will require a joint development project between most, if not all, members of the pharmaceutical supply chain. This does not only include the firms in the supply chain, but also the non-profit legal entities and other national authorities who interact with the supply chain, to uphold the rules and regulations within the pharmaceutical industry. Currently, the Falsified Medicine Directive suggests that it is the manufacturers in the pharmaceutical industry that should bear the cost of implementing the system suggested by the EU (European Commision, 2016). It could be argued that if a Blockchain solution was chosen, the manufacturers do not need to bear the entire cost, since there will be no need for a centralized institution to manage the system.

The Blockchain systems proposed in this thesis may seems overly simplified. It was never the goal of this thesis to provide a workable solution that could be implemented in the real world, but the goal was to highlight the features and capabilities of Blockchain technology. And from these highlights, this thesis demonstrates how it could function within the pharmaceutical industry. Others are encouraged to improve these proposals.

An important point regarding the use of Blockchain technologies is, whenever something is written to the ledger, it can't be changed or deleted. This differs from normal database management, where if someone makes an error, it could be fixed by looking up the relevant table and changing the information. Blockchain technology follows the same principles as accounting, where an entry made in error must be countered by another entry in order to return to the previous state.

Another area of research that seems interesting to me is a cost-benefit analysis between the current proposed system in the Falsified Medicine Directive and a similar Blockchain system. Do the benefits of a Blockchain solution outweigh the costs of a centralized system? While this thesis has worked on the implicit assumption that a distributed, decentralized system is better than a centralized system, more research into this matter is needed.

Currently, the Linux Foundation, along with many other firms such as IBM, are working on a Blockchain solution within healthcare (Hyperledger Project - The Linux Foundation, n.d.). This solution could very well be the one to be implemented in the real world.

From the interviews with the respondents (see 4.3), the wholesalers have a lot of influence on the pharmacies in Denmark, but in a symbiotic way. The pharmacies do not have to worry about the logistics of their purchases, since the wholesalers sell to them directly based on the inventory and sales figures provided by the pharmacies, which allow the pharmacies to focus on their core function, patient healthcare.

The proposed Blockchain systems all assume that there is a separate mechanism in place that allows the Blockchain systems to identify who has the authorization to perform certain tasks. While it is not covered in this thesis, such an authorization mechanism is a prerequisite for any of these Blockchain systems to function.

6.1 Reflection on the thesis process

At the beginning of the process, it was unclear as to how to proceed. With the help of my supervisor, it was determined that a case study on where Blockchain technology could be used in the pharmaceutical industry would be the best course of action.

While researching the current state of the pharmaceutical industry, I learned that a new EU directive, the Falsified Medicine Directive, was to be implemented in February 2019. What was interesting to me was the implementation of a centralized system, in which the purpose was to help authenticate if a medicinal product was genuine. Having a great interest in Blockchain technology, the problem of authenticating medicinal products seemed to be solvable by using Blockchain technology. And thus, this thesis was started.

The initial focus was to compare the Falsified Medicine Directive's requirement to Blockchain technology. But during my research, I learned that the procedures in the pharmaceutical industry is heavily influenced by the Good Distribution Practice guidelines. It was decided that this thesis should include Good Distribution Practices, since it requires manufacturers, wholesalers and pharmacies to work by certain standards. One key point is the amount of documentation required. Unfortunately, I did not have the opportunity to observe the documentation process, and could therefore only make basic assumptions based on the Good Distribution Practices.

The literature chosen for this thesis was a great help in improving my understanding of the supply chains and transparency. The articles that were most helpful, were articles that attempted to unite the theories of

previous articles and attempt to unify the theories, providing me a greater understanding on the the perpectives currently held by different groups of authors within each field.

It was relatively easy for me to contact a pharmacy and a wholesaler, who was willing to help. Unfortunately, the same can't be said about a pharmaceutical manufacturer. The intention was to do a multi-case study, gaining insights from the start, middle, and end of the pharmaceutical supply chain. However, gaining access to a pharmaceutical manufacturer proved to be so difficult, that I had to proceed with the work without input from the manufacturing part of the industry. While researching the state of the pharmaceutical industry, I had the great opportunity to interview a sales manager at NNIT, which provides IT-solutions to most pharmacies in Denmark. This gave me great insight as to how pharmacies and wholesalers communicate electronically. Personally, I feel that I have learned a lot about the pharmaceutical industry, but unfortunately, lacking the perspective of a pharmaceutical manufacturer.

The goal of this thesis was to highlight the capabilities and features of Blockchain technology and compare and evaluate them to requirements of the legislation and the effect it has on the pharmaceutical industry. It is my opinion, that the supply chain management and the levels of transparency within the pharmaceutical industry in Denmark would benefit from further research in this area.

7 Conclusion

The purpose of this thesis, was to determine whether Blockchain technology can be used or levereaged to provide transparency in supply chains of material goods, with a specific focus on the pharmaceutical industry. In conclusion, the reseeach prodived four main insigths.

First, the pharmaceutical industry is a highly-regulated industry, with respects to documentation as set forth the Good Distribution Practices guidelines. A high level of documentation is required to operate in this industry, and there are continually new regulations being implemented, such as the Falsified Medicine Directive.

Second, there is already a great deal of transparency in the pharmaceutical industry. Most Danish pharmacies use Vendor Managed Inventory services from their wholesaler, giving wholesaler complete insight into the sales of the pharmacy. In return, the wholesaler manages the pharmacy's inventory, knowing exactly what the pharmacies need at any given time, allowing the pharmacy to focus on their core discipline, patient healthcare. A high degree of transparency is also available through the documentation required by the Good Distribution Practices, as well in the future through the Falsified Medicine Directive.

Third, based on the empirical data available for this thesis, the wholesalers in the pharmaceutical industry have the highest awareness of the entire supply chain. Since most pharmacies in Denmark use a Vendor Managed Inventory solution, the pharmacies only focus on its nearest neighbors in the supply chain, the wholesaler and the public. The wholesaler has a more far-reaching view of the supply chain. Their gain insights on public consumption through the pharmacies, allowing them to better cooperate their own suppliers and the manufacturers.

Last, theoretically it is possible for Blockchain technology to accommodate for the demands in the pharmaceutical industry. Three different Blockchain systems were presented, each with their own roles. The first system focuses on compliance with the Falsified Medicine Directive. The second system handles compliance with Good Distribution Practices, while incorporating GS1 standards. The third system is based on the EPCIS standard by GS1, which allows for greater transparency in the pharmaceutical supply chain.

This thesis has shown that Blockchain systems can, in theory, be used to improve the level of transparency in the pharmaceutical supply chain.

8 References

Apoteksverk Føroya. (n.d.). *Tjaldurs Apotek*. Retrieved March 12, 2017, from Apoteksverk Føroya: https://www.apotek.fo/um-okkum/apotek/tjaldurs-apotek/

Banke, S. (2016, December 13). (J. S. Jacobsen, Interviewer)

Buterin, V. (2014, September 1). *White paper · ethereum/wiki Wiki*. Retrieved May 14, 2016, from https://github.com/ethereum/wiki/wiki/White-Paper

European Commision. (2013, November 23). Guidelines of 5 November 2013 on Good Distribution Practices of medicinal products for human use. *Official Journal of the European Union*.

European Commision. (2016, February 9). Official Journal of the Eurpean Union. *CDR (EU) 2016/161 of 2 October 2015 supplementing Directive 2001/83/EC of the European Parliment and of the Council by laying down detailed rules for the safety features appearing on the packaging of medicinal products for human use*.

Food and Safety Authority of Ireland. (2013, January 15). *Horse DNA found in some Burger products*. Retrieved from Food and Safety Authority of Ireland: https://www.fsai.ie/news_centre/press_releases/horseDNA15012013.html

GS1. (2016, September). EPC Information Services (EPCIS) Standard. Retrieved March 11, 2017, from http://www.gs1.org/sites/default/files/docs/epc/EPCIS-Standard-1.2-r-2016-09-29.pdf

GS1. (2017, February). GS1 System Landscape. Retrieved from GS1 Achi: http://www.gs1.org/docs/architecture/GS1_System_Architecture.pdf

GS1. (n.d.). *Standards | GS1*. Retrieved March 11, 2017, from Standards: http://www.gs1.org/standards

Hansen, P. (2016, December 9). (J. Jacobsen, Interviewer)

Harboe, T. (2009). *Indføring i samfundsvidenskabelig metode* (4. udgave ed.). Frederiksberg: Forlaget Samfundslitteratur.

Hyperledger Project - The Linux Foundation. (2016). *ConsensusFAQ - Hyperledger Fabric*. Retrieved January 1, 2017, from Hyperledger Fabric - readthedocs: https://hyperledger-fabric.readthedocs.io/en/latest/FAQ/consensus_FAQ/

Hyperledger Project - The Linux Foundation. (n.d.). *Healthcare - Hyperledger*. Retrieved March 12, 2017, from Industries / Healthcare: https://www.hyperledger.org/industries/healthcare

IBM. (2016, September 27). Building a blockchain for business with the Hyperledger Project. Retrieved March 12, 2017, from https://developer.ibm.com/tv/the-creation-of-hyperledger-fabric-v1-for-stable-blockchain-networks/

Lamport, L., Shostak, R., & Pease, M. (1982, July). The Byzantine Generals Problem. *ACM Transactions on Programming Languages and Systems, 4*(3), pp. 382-401.

Marshall, D., McCarthy, L., McGrath, P., & Harrigan, F. (2015, December 14). *What's Your Strategy for Supply Chain Disclosure?* Retrieved December 27, 2016, from MITSloan Management Reviews: http://sloanreview.mit.edu/article/whats-your-strategy-for-supply-chain-disclosure/

McGirvern, G., & Fischer, M. D. (2012). Reactivity and reactions to regulatory transparency in medicine, psychotherapy and counselling. *Social Science & Medicine*(74), pp. 289-296.

Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). *Journal of Business Logistics, 22*(2).

Mol, A. P. (2014). Governing China's food quality through transparency: A review. *Food Control*(43), pp. 49-56.

Mol, A. P. (2015). Transparency and value chain sustainability. *Journal of Cleaner Production*(107), pp. 154-161.

Mouritsen, E. (2016, December 30). (J. Jacobsen, Interviewer)

Nakamoto, S. (2008, October 31). Bitcoin: A Peer-to-Peer Electronic Cash System.

Nolsøe, A., & Schwartson, R. (2016, December 28). (J. Jacobsen, Interviewer)

Nomeco A/S. (n.d.). *Vendor Managed Inventory | Nomeco A/S*. Retrieved March 11, 2017, from Vendor Managed Inventory: http://www.nomeco.dk/en/vendor-managed-inventory

Schnackenberg, A. K., & Tomlinson, E. C. (2016, November). Organizational Transparency: A New Perspective on Managing Trust in Organization-Stakeholder Relationships. *Journal of Management, 42*(7), pp. 1784-1810.

Swan, M. (2015). *Blockchain* (First Edition ed.). O'Reilly Media, Inc.

Szabo, N. (1997, September 1). Formalizing and Securing Relationships on Public Networks. *First Monday, 2*(9).

The Guardian. (2013, February 15). *How the horsemeat scandal unfolded – timeline*. Retrieved from The Guardian: https://www.theguardian.com/world/2013/feb/08/how-horsemeat-scandal-unfolded-timeline

Walport, S. (2016). *Distributed Ledger Technology: beyond block chain.* London: UK Government Office of Science.

Wikipedia. (2016, April 5). *Smart Contract - Wikipedia, the free encyclopedia*. Retrieved May 16, 2016, from Wikipedia: https://en.wikipedia.org/wiki/Smart_contract

Wikipedia. (2016, December 13). *Transparency (behavior)*. Retrieved January 1, 2017, from Wikipedia, the free encyclopedia: https://en.wikipedia.org/wiki/Transparency_(behavior)

Wikipedia. (17. January 2017). *Spoke-hub distribution paradigm*. Hentet 13. March 2017 fra Wikipedia - The Free Encyclopedia: https://en.wikipedia.org/wiki/Spoke%E2%80%93hub_distribution_paradigm

Yin, R. K. (2014). *Case Study Research - Design and Methods* (5. Edition ed.). California: SAGE Publications, Inc.

9 Appendix

9.1 Case Study Protocol

Overview

This case study protocol is meant to be used by the researcher of the case study. This protocol list the main theoretical concepts used during the research, and lists the main questions to be answered by the researcher.

If this protocol is handed to anyone other than the researcher, then the most relevant sections to read are the following:

- Case Study Background (Page 58)
- Case Study Goals (Page 58)
- Operationalized Questions (Page 62)

This case study protocol is part of the thesis written by John Schwartz Jacobsen, a CBS student, currently studying MSc in Business Administration and Information Systems.

Quick Facts

Student Name: John Schwartz Jacobsen

Student E-mail: joja08ab@student.cbs.dk

Study Course: MSc in Business Administration and Information Systems

Thesis Research Question:

> How can blockchain technology be used (or leveraged) to provide transparency in supply chains of material goods?

Thesis Abstract:

This thesis will research the state of transparency in the pharmaceutical industry. Currently, the pharmaceutical is a highly regulated industry, which requires a certain level of transparency. However, this thesis will attempt to ascertain if the level of transparency is set as a reaction to regulation alone, or if members of the industry's supply chain have implemented their own levels of transparency. After finding the level of transparency of the cases researched in this thesis, an analysis of the transparency demands

and the capabilities of blockchain technology is performed and the two are compared. Since blockchain technology is still in its nascent state, this thesis will not design a fully functioning system, but simply highlight some of the use cases in which blockchain technology can be used.

Case Study Background

The purpose of this case study, is to research if blockchain technology is a good candidate, with regards to auditability, traceability and connectivity in the pharmaceutical industry.

With regards to auditability, blockchain technology support auditability from the ground up. Since all the blocks are linked, and all transactions are record, it is easy to perform such audits, with regards to traceability.

Since blockchain technology is meant to be a shared platform, it should be "easy" to connect and setup. Legacy systems can be connected to the blockchain platform. Since everyone has a copy of the blockchain, it is easy to retrieve data and perform analysis upon the data in the blockchain. With its peer-to-peer capabilities, it should have a high reliability with regards to uptime.

Case Study Goals

This case study focuses on information disclosure. Specifically, the units of analysis are:

- The elements of information disclosure. Specifically, the focus in on the ways the information is shared and used. This unit aims to answer the transparency and supply chain elements of the research question.
- The 'how' of information disclosure. This unit has a more technical aspect to it. It is used to answer the technological part of the research question, specifically regards to blockchain technology.

The goal of the case study research, is to learn of the state of transparency in the Danish pharmaceutical supply chain. And with regards to the state learned, a comparison with the current transparency practices and possible future practices, and blockchain technology.

Theoretical Framework

This section is meant as a very brief description, mostly served as a reminder to the researcher. The full descriptions will be in the actual thesis.

Transparency

Transparency, in this study, is regarded as the disclosure of information.

Transparency Types

There are four ideal types of transparency: management-, regulatory-, consumer-, and public transparency (Mol, Transparency and value chain sustainability, 2015). In this paper, I will focus on the two first types of transparency. However, I will briefly go over all the different types of transparency.

Management Transparency

This version of transparency has its origins in the management sciences and logistics (Mol, Transparency and value chain sustainability, 2015). This can be seen in the practical application of theories such as Total Quality Management, traceability in supply chains, and verification of product specification (Mol, Governing China's food quality through transparency: A review, 2014). The level of transparency is usually limited to actors within the value-chain, and is as such not available to the public (Mol, Governing China's food quality through transparency: A review, 2014; Mol, Transparency and value chain sustainability, 2015).

Regulatory Transparency

The regulatory type of transparency relates to the requirements set by regulatory bodies, demanding disclosure of certain information (Mol, Transparency and value chain sustainability, 2015). Examples of this are track-and-trace policies or provenance information.

It is argued that regulators use transparency standards to affect professionals' attention on "doing the right thing", thereby affecting and controlling the norms of professional practices (McGirvern & Fischer, 2012).

Consumer Transparency

This type of transparency involves the disclosure of product information and production, often related to claims of sustainable production processes. These disclosures often result in some form of labelling or certification of products or processes (Mol, Transparency and value chain sustainability, 2015).

Supply Chain

SCM Activities to Implement the Philosophy

To embrace the SCM philosophy, authors of the supply chain literature has proposed a list of activities that are necessary that firm adopt (Mentzer, et al., 2001).

SCM Activities
Integrated Behavior
Mutually Sharing Information
Mutually Sharing Risks and Rewards
Cooperation
The Same Goal and the Same Focus on Serving Customers
Integration of Processes
Partners to Build and Maintain Long-Term Relationships

Table 4 SCM Activities (Mentzer, et al., 2001)

Supply Chain and Supply Chain Management

A supply chain has three levels of complexity:

- Direct
- Extended
- Ultimate

Before a firm can implement supply chain management, the firm must have supply chain orientation.

Supply Chain Transparency

Transparency is the disclosure of information. While the literature regarding is vast, this paper will focus on one model of supply chain transparency: The Supply Chain Disclosure Radar (Marshall, McCarthy, McGrath, & Harrigan, 2015).

Membership

Supply Chain Membership refers to information regarding a firm's suppliers. Sometimes it is only the direct suppliers of the firm which is disclosed, but in other cases, i.e., Nike has disclosed the comprehensive supplier list for its entire product range (Marshall, McCarthy, McGrath, & Harrigan, 2015).

Provenance

Provenance refers to disclosure of information regarding the materials used in the production of a product, the source location of the materials, and details on how the materials are extracted or produced (Marshall, McCarthy, McGrath, & Harrigan, 2015). Most commonly, this is done to meet regulatory or professional standards.

Environmental Information

Firms that include a corporate responsibility strategy, must report and disclose information regarding their environmental impact. This could include information such as carbon emissions, energy usage, water usage, levels of waste produced in the supply chain (Marshall, McCarthy, McGrath, & Harrigan, 2015).

Social Information

In this case, organization provide information regarding labor policies, human rights, and social impacts within the supply chain (Marshall, McCarthy, McGrath, & Harrigan, 2015).

Blockchain Technology

Blockchain technology is also called a ledger technology. As the same suggests, the basic function of blockchain technology is being an open, public ledger. However, since it is built upon peer-to-peer principals, sharing data is very simple. Every participant has a copy of the entire ledger. All transactions are stored in blocks in the blockchain, which are all cryptographically linked together. This cryptographic linkage makes the blockchain immutable. It is possible to encrypt data on the blockchain, making the encrypted data available only to the participant who have been given permission.

At the time of writing, blockchain technology is still nascent, and is not widely implemented yet. However, there is great interest in blockchain technologies in areas such as finance, provenance, etc.

Data Collection Procedures (for the researcher)

Introductory e-mail link:

Name(s) of the contact person(s):

Data Collection Plan:

Interviews

During interviews, a voice recorder will be used, given that the interviewee permits this. The level 2 questions listed in Operationalized Questions will be 'translated' into level 1 questions by the interviewer, adapted as the situation calls it.

Expected preparation prior to fieldwork:

Things the interview must bring:

- Voice Recorder
- Pen and paper
- A copy of this case study protocol

Data Collection Questions

This section covers some of the questions that the researcher asks themselves (level 2 questions). The researcher will use these questions to form level 1 questions that are asked to the key persons during fieldwork, i.e., during interviews and observations.

Operationalized Questions

Transparency

- What information is disclosed on a management level (Management Transparency)?
    - Logistics, Quality Management, Verification, Traceability?
- What information is disclosed with regards to regulations and laws (Regulatory Transparency)?
    - Traceability, Track-and-Trace
- What information is disclosed on a consumer level (Consumer Transparency)?
    - Certifications, Labels
        - Standards (ISO?)
        - Sustainability
- What information is disclosed to the public (Public Transparency)?

Supply Chain

- How does the firm view the length of its supply chain? (Complexity of supply chain)?
    - Direct, Extended, Ultimate
- Does the firm make any attempts to manage its supply chain? Or is the firm only aware of the state of its supply chain? (Supply Chain Orientation)
- Does the form perform any action with its supply chain partners (Supply Chain Management Activities)?
    - Does the firm have any external integration with supply chain partners (Integrated Behavior)?
    - Does the firm share any strategic or tactical information with supply chain partners (Mutually Sharing Information)?
    - How does the firm share risks and rewards with its supply chain partners, if at all (Mutually Sharing Risks and Rewards)?
    - Does the firm coordinate any activities with supply chain partners (Coordination)?
        - Complementary, coordinated activities?
    - Does the firm believe that along with the supply chain partners, they share the same goal and focus on serving customers (The Same Goal and the Same Focus on Serving Customers)?
    - Are any of the firm's processes integrated with its supply chain partners (Integration of Processes)?
    - Has the firm engaged in partnerships/relationships with its supply chain partners (Partners to Build and Maintain Long-term Relationships)?
- From a management viewpoint, if and how are the firm's processes integrated, specifically regarding the flow of material goods in the supply chain (Supply Chain Management Processes)?

Supply Chain Transparency

- Does the firm disclose which suppliers make up its supply chain (Membership)?
- Does the firm disclose what, how, and where the materials come to the firm's possession (Provenance)?

- Does the firm disclose information regards its usage of the following: (Environmental)?
    - Water
    - Energy
    - Waste
    - Carbon
- Does the firm disclose information regarding: (Social)?
    - Labor policies
    - Human rights
    - Social Impacts

Operationalized Variables

1. Transparency
    a. Management Transparency
    b. Regulatory Transparency
    c. Consumer Transparency
    d. Public Transparency
2. Supply Chain
    a. Complexity of supply chain
        i. Direct?
        ii. Extended?
        iii. Ultimate?
    b. Supply Chain Orientation
        i. "if its management can see the implications of managing the upstream and downstream flows of products, services, finances, and information across their suppliers and their customers."
    c. Supply Chain Management Activities
        i. Integrated Behavior
        ii. Mutually Sharing Information
        iii. Mutually Sharing Risks and Rewards
        iv. Coordination
        v. The Same Goal and the Same Focus on Serving Customers
        vi. Integration of Processes
        vii. Partners to Build and Maintain Long-term Relationships
    d. Supply Chain Management Processes
3. Supply Chain Transparency
    a. Membership
    b. Provenance
    c. Environmental
    d. Social
4. Blockchain features and capabilities
    - Immutable transaction log
    - Shared platform
    - Smart Contracts
    - Events
    - Auditability

9.2 Interview Subjects

Richard Schwartson

Richard Schwartson is the head of IT at Landsapotekarin (part of the State Pharmacy) in Faroe Islands.

Allan Nolsøe

Allan Nolsøe is the head of Finance and Operations at the State Pharmacy.

Elin Mouritsen

Elin Mouritsen is the pharmacist in charge of logistics at the pharmacy "Tjaldurs Apotek" in Faroe Islands, which is part of the State Pharmacy. Elin Mouritsen is also the person in charge of their Good Distribution Practices.

Steen Banke

Steen Banke is the sales manager at NNIT, which is the primary IT-solution provider in the life sciences industries, which includes the pharmaceutical industry, in Denmark.

Per Hansen

Per Hansen is the logistics director at Nomeco, a pharmaceutical wholesaler located in Denmark.

9.3 Interview transcripts

Per Hansen

[00:02:05.26] Per Hansen: ... det der er vedtaget i Europa, er en end-to-end kontrol. Og d.v.s, at det er producenten der indrapportere serienummeret til en europæisk database, og det er apoteket der trækker det ud. Hvad der ligger inde imellem der af transaktioner, er ikke omfattet af lovgivningen.

...

[00:02:32.12] Per Hansen: Men derfor kan det godt være en mulighed, at aktører udveksler event data, måske henholdt EPCIS standarden eller andre. Så der er jo nogle muligheder forbundet med den nye lovgivning. Så det kan give en synlighed i supply chainen.

...

[00:04:00.10] Per Hansen: Det er en standard (EPCIS), der relaterer sig til event data. Og det vil sige at, hvis vi gør noget som [wholesaler?], så kan vi indrapportere til producenten via denne her standard. Og det er jo det der kan skabe denne her synlighed, som du er efter, hvis du vil belyse det. Men kunne jo sagtens være nemlig at se "okay, hvad er det for nogle metoder der kan skabe den synlighed i supply chainen som du måske kan sige mig", men det er ikke det som er i lovgivningen.

...

[00:04:41.20] Per Hansen: Men vi kan bare se som grossist og [clearhussaler?], der er der flere der efterspørger muligheden for at vi kan levere de her event data. Så derfor er det interessant for os at finde ud af, hvad er der hovedet eller hale på det her.

...

[00:09:13.14] John Schwartz Jacobsen: Man kommer nok ikke til at bruge EPCIS i Danmark, tror du? eller i EU?

[00:09:20.23] Per Hansen: Det skal jeg ikke kunne udelukke.

[00:09:24.27] John Schwartz Jacobsen: Men der er i hvertfald ikke taget nogen beslutning til det i hvertfald?

[00:09:27.26] Per Hansen: Nej, det kommer heller ikke til at ske via EU, for det kommer til at ske blandt de lægemiddelproducenter og de aktører - som grossister og andre - som går ind og understøtter, kan man sige, det fysiske flow af lægemidlerne i Europa. Og det kommer jo til at være et samspil imellem at producenterne ønsker og se events af hvad der sker, på hvilken som helst af serienummerne. Og det er det EPCIS understøtter. Om det er det der bliver valgt, eller om det er kun en fraktion af leverandørerne der vælger det, det er alt for tidligt at sige noget om.

...

[00:13:23.28] Per Hansen: Vi er jo meget optaget af hvad der skal ske frem imod 2019, ik? Så selvfølgeligt optager det os. Specifikt er det jo også, hvad opstår der i kølvandet på det? For det første, hvad er det for nogle omkostninger vi kommer til at påføre os? Og hvad er det der opstår i kølvandet, som vi kan udnytte. Men du skal også være opmærksom på, at der er jo fra industriens side, altså lægemiddelproducenternes side, der er jo også et ønske om, jo mere transparent der er, jo mere kan de jo også lukke af for den parallel export/import der er i Europa.

...

[00:14:43.07] Per Hansen: ... jo mere visibilitet du vælger at lægge i supply chainen for lægemiddler, jo større muligheder er der for orginal industrien i at lukke af for parallel importeret produkter. Og d.v.s., at det har Staten Danmark ikke stor gavn af, fordi der er jo trodsalt nogle 100 millioner, som de parallel importerede lægemiddler sparer samfundet.

...

[Diskution om praktiske elementer til opgaven]

Steen Banke

[00:01:02.01] Steen Banke: Bare så du er klar over de eventuelle begrænsninger, der kan være i min tilgang. Det er helt klart apotekerne jeg ved mest som. Jeg kender også en del til det andet, men det skal du nok supplere med input fra andre.

...

[00:01:46.03] John Schwartz Jacobsen: I forhold til apotekerne i Danmark, hvad er det for nogle produkter i egentligt leverer?

[00:02:03.09] Steen Banke: Vi har drift, udvikling og vedligehold af en IT-løsning der oprindelig er lavet af Danmarks Apotekerforening, og det er også stadig dem der ejer den. Det er sådan et medlemstilbud man har, at de kan komme på deres foreningsejen IT-løsning, og det er der cirka 3/4 dele af apotekerne der benytter i dag. Vi har omkring 170 af de 230 apoteker der findes, af hovedapoteker, som kunde. Og IT-løsningen indgår egentligt alle IT-understøttede områder på et apotek, d.v.s., du skal have en point-of-sale løsning, du skal have noget til et skrankesystem du kan slå i kassen på, du skal have et bogholderisystem du kan bruge til at danne det regnskab du skal aflevere og holde styr på debitorer og varelager o.s.v. Du skal have et logistiksystem, hvor man kan få bestilt vare hjem til apoteket. Du har et receptursystem; det er egentligt livsnerven i apoteket, det er jo recepter der bliver ekspederet eller ordinationer der bliver behandlet, sådan at folk kan få deres medicin, at man får tilskrevet de tilskud man har ret til fra det offentlige, at man får indberettet den medicin folk køber og henter på apoteket til en central base som man, uanset hvor man bliver behandlet i den primære sektor, kan så ind og se hvordan er medicineringen af det her personnummer.

[00:04:07.00] Steen Banke: Det spænder egentligt meget vidt, det er jo også at kunne kommunikere - der er utroligt meget elektronisk kommunikation mellem apoteket og deres partnere. De får jo recepterne elektronisk, når de bliver ekspederet på lægehusene. De sender deres vare-bestillinger til en af de to grossister elektronisk, de får ordrebekræftelser elektronisk, de laver betalingerne elektronisk. De kører selv opkrævningssystemer over for deres kunder der ikke kommer i butikken. Der er jo traditionelt 2 typer apoteker: der er by-apotekerne der har næsten al deres omsætning i skranken, og så er der lande-

apotekerne som har en meget stor del af deres omsætning på det man kalder forsendelser, altså hvor medicinen bliver bragt ud til kunden eller bliver bragt ud til et udleveringssted - en lille købmand, en brugs eller et eller andet - som så udleverer og opkræver penge og afleverer dem til apoteket.

[00:05:27.10] Steen Banke: Det rækker faktisk temmelig vidt, og det er et område der er mange offentlige støttekroner i, så det er meget, meget heftigt reguleret af myndighederne.

...

[00:05:45.06] Steen Banke: Vi har som sagt 170 apoteker som kunder, og vi betjener i alt-- de har jo nogle apoteker har en eller flere filialer, eller det kan være et apoteksudsalg. Vi har cirka 350 enheder vi passer rundt omkring i landet.

[00:06:10.04] Steen Banke: Og det der er meget fokus på, det er at de sidder på et monopol, så de er jo nød til at opføre sig ordentligt fordi ellers så er der jo nogen der siger: "så kan vi ikke være (tjent?) med at have det som et monopol, så er det bedre at lægge det ud i frikonkurrence." Men det er jo en af de få sektorer der er tilbage, hvor der stadigvæk er monopoltilstande, selvom der er blevet åbnet gradvis over årene. Så skal man jo forsat være uddannet farmaceut, og man skal have en bevilling af Sundhedsministeriet for at kunne drive et apotek.

...

[00:07:22.10] Steen Banke: Der er jo stort set kun 2 grossister i Danmark. Tjellesen - eller TMJ (Tjellesen Max Jenne) - og så Nomeco. Nomeco er cirka dobbelt så stort som Tjellesen. Tjellesen har omkring 1/3 af markedet, og Nomeco har omkring 2/3 af markedet. Sådan har det ligget i mange år. De bokser lidt med hinanden, de skubber så lidt en gang imellem - det går op, det går ned - men set over de seneste 20 år, så har det ligget på der her niveau i alle årene. Der har været forsøg fra nye grossister for at etablere sig på det danske marked, men indtil videre er det ikke lykkedes. Og der er nogle begrænsninger, altså nogle "barriers to entry" i det her marked. Et er at, de 2 grossister, for efter hånden mange år siden - jeg tror det er 25 år siden - blev enige om en protocol, som man ville benytte i forbindelse med elektronisk vare bestilling. Og nye grossister der har forsøgt at etablere sig, vil jo også gerne modtage elektroniske

varebestillinger fra de apoteker de skal handle med. Og der får de så at vide, at så må de finde en ny måde at gøre det på, fordi denne her protocol, som de kalder (pharmalink), der er en vi har udformet og der har de faktisk fået rettens ord for at den er der ikke andre der bare må bruge uden videre. Der lykkedes det dem på et tidspunkt at få nedlagt et (??)-forbud, så du kan ikke bare tage pharmalink i brug. Det er skam ikke fordi vi vil holde jer ude, men vi har jo investeret millioner i det her udviklingsarbejde, så hvis I nu køber en billet på - de priser som jeg normalt har hørt, det er omkring 3/4 million - så kan i få lov at bruge pharmalink.

[00:09:53.07] Steen Banke: Og det er noget af det, som en nyoprettet virksomhed ikke synes er skide sjovt, og skulle til at bruge penge på. Den (billetten til pharmalink) bliver sådan egentligt et rimeligt effektivt værn. Så har de 2 grossister også forsøgt at etablere deres eget produkt, hvis man kan sige det sådan. Nomeco, de store, har et konsept de kalder for VMI, d.v.s., Vender Managed Inventory. D.v.s, at det er grossisten der reelt styrer apotekets lager. De siger "ved du hvad? Du skal slet ikke have besvær med og styre dit lager, fordi det er vi specialister i. Du har kun dit ejet lille lager, vi har lager i stor skala, og vi vil gerne gøre det for alle apoteker der er kunde hos os, så nu laver vi en aftale om at vi engang i døgnet, der får vi dine salgs- og lagertal, og ud fra det og så nogle aftaler om hvilke produktgrupper det er vi handler indenfor og hvad du mener skal være førstevalg i de forskellige substitutionsgrupper, så kan vi generere en ordre til dig. Den bekræfter vi bare, og næste morgen står dine varer ude hos dig". Og det er der mange apoteker, som siger "Det var dejligt, jeg kan afskede en logistikmedarbejder, det behøver vi ikke mere at have en der stort set bruger hele sin tid på at styre vores lager og sådan noget. Det klarer min grossist. Og så kan det da godt være, at det ikke er fuldstændigt lige så knivskarpt som hvis jeg selv gjorde det, fordi de kender ikke alle de lokale forhold, men hvis jeg kan spare 3-400.000 om året i en lønning, så gør det ikke noget at der er lidt der smutter på den anden konto". Og grossisten siger " Fedt! Nu fik vi det apotek til at spare deres logistikansvarlige ud, de sidder mere eller mindre i saksen, fordi hvis de ikke vil handle med os, så skal de handle med Tjellesen, og Tjellesen har ikke en VMI løsning, og så skal apoteket selv til at finde en logistikansvarlig - enten ansætte en der kan det, eller selv uddanne en - og det tager tid og det er dyrt."

[00:12:42.16] Steen Banke: På den måde holder de også fast i kunden. Tjellesen, eller TMJ, har omvendt opfundet et begreb de kalder VBO - Vare BestillingsOptimering - hvor man siger "Vi mener den bedste løsning for apoteket, det er at man selv har styr på sit lager, fordi det er ude på det enkelte apotek man kender kunderne og ved at den kunde plejer altid og ville have det produkt, selv om det måske ikke er de billigste, så skal vi sørge for at have det hjemme o.s.v., o.s.v.

[00:13:22.18] Steen Banke: Der er de 2 forskellige strategier og så krydrer Tjellesen det også med at hvis du så også vælger VBO+, så går vi ind og bogfører dine ordrer og laver noget at dit lagerbogholderi, så du ikke selv skal bruge tid på det, og de har laver en meget avanceret løsning til og styre returordre elektronisk som man kan via en håndterminal kan gå ud og-- man får at vide hvilke varer der skal plukkes og returneres og sådan noget. Det er noget af det der faktisk er vigtigt for et apotek, det er at styre returen, fordi du skal returnere inden der kun er 6 måneder tilbage inden udløb(sdato), så kan du stadigvæk få pengene tilbage igen. Hvis det går over, så får du ikke dine penge. Så der er rigtig mange penge og spare ved at styre sin retur korrekt.

[00:14:19.27] Steen Banke: Så derfor har det været ekstrem svært for nye grossister og komme ind på markedet. Og der er hellere ikke kommet nogen.

..

[00:14:34.19] Steen Banke: Og det er svært også at komme ind fordi, de rabatordninger der findes-- du må godt give rabatter fra grossist til apotek, men det skal være omkostningsbetinget rabatter. Og der siger de eksisterende grossister "nå ja, men hvis du bare køber alle dine vare hos mig, så spare vi noget ved at vi ikke skal styre nogle at dine varer, og en anden skal styre nogle at de andre--". Tidligere - for en 10-15 år siden - der var det helt normalt at der havde apotekerne-- der handlede de med begge grossister. Fordi hvis den éne ikke havde varen, så kunne man lige få det over hos den anden. Man stillede dem hele tiden lidt ud mod hinanden. Det gør man ikke i dag, der får du en bedre økonomi ved at handle det hele ét sted; det er der du får den største rabat på dit varekøb.

...

[00:15:34.17] Steen Banke: Den løsning vi har, som du kan høre, så er det noget med at på VMI, der afleverer man salgs- og lagerdata en gang i døgnet, og så beregner Nomeco selv hvad der skal leveres. VBO, der (pharmanet?) kan danne en behovsberegning, og det er ud fra den der bliver bestilt hos TMJ. Så al kommunikation omkring logistik og vareindkøb, foregår meget elektronisk. Der er stort set ikke nogen tilbage, der sidder med telefon og siger "nu er jeg nået det tidspunkt på eftermiddagen, hvor jeg lige skal have ringet til grossisten og fortalt hvad vi skal have bestilt til hvad de kan levere i morgen". Det gør man ikke, det fuldautomatisk idag.

...

[00:16:38.29] John Schwartz Jacobsen: Så er det lige denne her vinkel her, med Falsified Medicine Directive - EUs nye direktiv. Har det sådan set nogen betydning for jer og for jeres produkter?

[00:16:51.14] Steen Banke: Det kan jeg fandme love det har. Det betyder en hel del. For det første, så vil det kræve der skal laves en del om i systemet, for den måde man bestyre det her på, er ved samtidigt at gå over i QR-koder, eller 2-dimensionelle stregkoder på pakningerne, så producenterne har en kæmpe opgave i og omlægge deres produktion og pakningslinjer, så man kan arbejde med 2-dimensionelle stregkoder, fordi du skal have mere end bare et varenummer pakket ned i stregkoden. Hvis du skal gøre det her let, så er du nød til at gemme flere data; du er nød til at gemme et batch-nummer, du kan nok samtidigt med fordel også gemme et udløbsnummer eller en udløbsdato, så man for det registreret. Mange apoteker benytter i dag det man kalder en lager robot, altså hvor varen bliver lagt på lager af en automat-- der er et kaoslager, du kan ikke bare sige at det produkt ligger altid på 4. hylde til højre eller sådan et eller andet. Det ved man ikke, det er et kaoslager som robotten selv styrer og optimere - den kører tit om natten og optimere sit lager - den kan jo se, hvad er det for vare der sælges meget af og sælges lidt af, og så flytter den varerne rundt i robotten, for at optimere eller minimere køretiden o.s.v. på at plukke-- de varer der sælges mange af, de bliver lagt tæt ved udkastet, så den ikke skal køre hele robotten igennem mange gange om dagen for at hente sådan et produkt - det bliver lagt lige ved udkastet.

[00:18:45.11] Steen Banke: Problemet ved sådan en robot, det er at hvis man ikke får tastet en stregkode ind når man lægger produktet på lager, så styrer den ikke rigtig efter udløb. Og det er idag hvor du skal taste udløbet ind for langsommeligt. De fleste gør det ikke, de lægger det bare ind, og en gang imellem - måske engang i kvartalet - så tømmer de visse produkter ud og siger "hvad har vi her, der er ved at blive for gammelt? Hvad skal vi have returneret?", og dem der så kan holde et kvartal mere, de ryger i robotten igen, og bliver lagt på plads. Men det er et ret omfattende arbejde, og der kunne man spare meget hvis man, ved at skanne stregkoden, også fik udløbsdatoen og fik den registreret. Det er en af de fordele apoteket kan få i forbindelse med de ændringer der kommer med det her medicin forfalskning. Men der skal jo bygges et stort system op, sådan at når du skanner et produkt i skranken, eller inden du pakker det ned, fordi det skal sendes ud til en kunde, så skal den jo slå op i central base for at se, er det her et ægte produkt eller er det noget som faktisk allerede er registret ud? Det kræver nogle ret omfattende systemer.

...

[00:21:02.09] Steen Banke: Men det er helt klar også-- Det kan havde nogle fine gevinster, fordi du kan jo så-- du øger jo sporbarheden. Du kan jo se, det produkt, det batch-nummer, den produktionsdato, hvor det er endt henne. Hvis du skal trace noget for at tilbagekalde ting, det kan du jo ikke idag. Når det ryger ud over skranken i apoteket, så er det væk. Så kan du ikke se hvem fanden har fået det her. Men du får den fordel at du kan spore produkterne helt ud til slutbruger.

...

[00:21:43.03] John Schwartz Jacobsen: Du snakkede om det her centrale system, hvordan ville det fungere? Er det bare et stort europæisk system som alt bare ligger i eller?

[00:21:51.18] Steen Banke: Det som jeg har hørt, så bliver det bygget op at nogle nationale centre. Så man har ligesom sådan nogle hubs, et i hvert land. Så taler de sammen, men når man står på danske apoteker og skal udlevere noget, så spørger man i den danske del. Og så ved jeg ikke, så er der givet vis en masse intern kommunikation mellem de her centre, hvor de spejler oplysninger og sådan noget.

...

[00:22:25.09] Steen Banke: Jeg ved at man i øjeblikket grossisterne er ude at se på hvilken løsning de mener ville være den bedste. Danmarks Apotekerforening er med i det, og de har været her for et par måneder siden i England og se på et engelsk system, de var en tur i Berlin for at se på et tysk system. Det er ligesom de 2 der findes på markedet, det er de 2 der kommer til at blive brugt i Europa.

[Afsluttende samtale]

Richard Schwartson and Allan Nolsøe

[00:00:26.24] Richard Schwartson: Altso, tað sum er interessant hjá okkum, tað er sjálvandi at vit hava eina KT-skipan, sum í 2019 skal på onkra máta gearast aftur ímótir tí sum vit leverar, t.v.s., Nomeco. Í dag er tað

sjálvandi Nomeco sum tryggar at vørurnar sum vit keypa eru í ordan. Líka sum rávørurnar sum vit keypa frá t.d. Fargron verður tryggja har niðri frá.

...

[00:01:47.25] Allan Nolsøe: Altso fyri okkum er hetta her bara eyka arbeiði.

...

[00:14:31.02] Allan Nolsøe: Men eg trúgvi ikki uppá ein skipan sum ger nakað sum helst annað, enn heldur eyga við um heilivágur er korrekt ella ikki. Altso um hon er ektaður ella ikki.

...

[00:14:59.01] Allan Nolsøe: Tí at tað vit hava brúk fyri í Føroyum, tá vit selja út til kundarnir hjá okkum, er ikki tað sama sum man hevur brúk fyri í Danmark. Ongastaðni fert tú at fáa eina skipan sum klárar at taka hædd fyri øllum tí sum øll hava brúk fyri. Tí hava vit brúkt nógvar pengar uppá okkara skipan, og í Danmark brúkar man nógvar pengar uppá eina aðra skipan. Og soleiðis er tað allastaðnis í Evropa. Tað at fara at fáa eina kassa skipan sum kan selja hesa vøruna-- so skal skipanin eisini kunna selja alt annað sum ikki er heilivágur, kann man siga. Altso alt tað sum bara er krem ella okkurt sovorið. Og hvussu fáa vit tað skipanina, tá vit selja? Vit kunnu ikki hava tvær skipanir tá vit selja. So tað trúgvi eg slett ikki uppá.

...

[00:17:08.25] Allan Nolsøe: Tí at eg trúgvi at simplari tað er, nemmari er tað at fáa tað ígjøgnum.

[00:17:15.03] Richard Schwartson: Tekniskt sæð, er tað einki problem at uppdatera databasur aftur og fram. Tað verður gjørt allatíðina.

[00:17:20.11] Allan Nolsøe: Tað er bara at tryggja sær, at hann ongantíð kann rættast í. Sovorin ting havi eg slett ikki forstand uppá.

...

[00:19:24.20] Allan Nolsøe: Eg trúgvi uppá okkurt sum er so simpult at tað hevur minst møguliga ávirkan á verandi skipan hjá øllum.

[00:19:37.15] John Schwartz Jacobsen: Hugsar tú so IT-skipanir ella mannagongdir eisini?

[00:19:39.26] Allan Nolsøe: Ja, bæði. Bæði mannagongdir og KT-skipanir, tí at eg hevði ímynda mær, at nú eru vit so heldig at nú eru vit uttan fyri EU. So vørur sum vera sendar til Føroyar, tær skulu skannast út av

Nomeco í Danmark. So teir skanna tað út, pakka tað til okkum og senda tað til Føroyar. Tí at Føroyar eru uttanfyri EU, lóggevingsmessigt behøvast vit ikki at skanna tað út tá vit selja tað (heilivágur).

...

[00:20:40.15] Allan Nolsøe: Vissi vit hugsa okkum, at vit skannaður út til kundarnir. So billi eg mær inn at vit høvdu gjørt eina-- so hevði okkara skipan fingið eina integration við hetta bókhaldssystemið (blockchain skipanin), sum gjørdi at tá vit skannaðu vørina til kundan, og prísurin kemur fram, so fór eisini eitt signal niður í henda her databasuna, sum segði at, ok henda vøran er kurant, hetta er í ordan. Og vissi tað ikki var, so kom eitt stórt reyt skelti upp, sum segði "stop" ella eitt ella annað. So má man taka hana til síðis og so skanna eina aðra. Og so høvdu vit ikki meira við hetta her at gera. Tí at so høvdu vit ikki broytt nakra mannagongd, og tað einasta sum vit skuldu brúkt pengar uppá, tað var at fáa eina integration frá okkara skipan niður í hendan her platform, sum liggur og heldur stýr á øllum.

...

[00:24:24.00] Richard Schwartson: Tað eftirlýsa vit, at vit høvdu fingið ta informationina við hjá okkum uppá eitt tíðspunkt. Soleiðis, at tá vit skanna vøruna inn, t.d., inn við robottin, so fáa vit samstundis útløbsdato. Tað hevði verið genialt.

...

[00:24:57.18] Richard Schwartson: Og tað sum er hjá okkum, tað er tað at Nomeco kennir øll útløbsdato. Vit fáa hvønn mánað ein lista. Tað sum vit hava spurt Nomeco um, kunnu vit ikki fáa elektronisk-- Vit fáa vørunar heim, vit skanna tað inn við robottin, vit fáa bara varenummari. (Striki)koduna er bara varenummari, onki meir.

[00:25:18.03] Allan Nolsøe: Tað er langt úti at teir ikki kunnu koyra útløbsdato í eisini.

[00:25:22.10] Richard Schwartson: So senda teir okkum teir okkum einaferð um mánaðin "hesa vørurnar eru við at útganga", og so skulu vit til at manuelt, meir ella minni semi-manuelt, til at finna hesa vørunar og so taka teir út aftur. So tað undrar meg eitt sindur hví í vit ikki kunnu fáa eina elektroniskan fíl, sum kunnu leggja inn í AX (Dynamics AX), hvar vit so sjálvur hondtera útleyp.

...

[00:29:38.11] Allan Nolsøe: Av tí at tú hevur monopol í Føroyum, egentliga. Og vit keypa frá einum grossisti í Danmark, so skal tað vera øgiliga organisera áðrenn tað (forfalska heilivág) endar í Føroyum.

...

[Complexity of supply chain - spørgsmål ledende til direct supply chain]

[00:33:47.27] Allan Nolsøe: Nej (hugsar ikki longur enn direct), ikke tá kemur til receptpligtig medicin.

...

[00:34:26.05] Allan Nolsøe: Vit hava ikki ordiliga orku til at-- Tað at fara út og so kanna leverandørarnir hjá Nomeco...

...

[00:36:46.08] Allan Nolsøe: Vit deila faktiskt ikki (data - lagurstatus, inventory). Vit bíleggja hvørja viku frá Nomeco, tað sum vit

[00:36:54.11] John Schwartz Jacobsen: hava brúk fyri

[00:36:55.07] Allan Nolsøe: Ja. Sjálvandi, vit fáa hagtøl frá Nomeco um hvat vit hava selt. Also, av tí at vit bíleggja (alt) frá teimum, so vita teir akkurát líka væl sum vit, hvat tað er sum vit selja.

[00:37:09.01] John Schwartz Jacobsen: Ongin hemligheitur har.

[00:37:10.06] Allan Nolsøe: Tað ber slett ikki til, tí at teir levera tað. So teir fylgja væl við hvat vit keypa og hvat vit returnera. So tað vita teir líka væl sum vit. Teir kenna ikki søluprísin hjá okkum ella sovorit, tað er púra vanntætt. Vit deila heldur ikki aðra upplýsingar, tí at nógv av hesum er umfata av persónsdatasikkurheit. Tí tað er persónlig preparatir, sum fólk brúka. Tað er so lukka sum tað kann. Men sjálvandi, heilsutrygdin er tann næsti parturin í hesum her, sum veitir nógvan stuðul, also peningarliga stuðul, til tað sum vit selja til fólk. So tey hava eisini hagtøl fyri hvat verður selt. Men tað er jú í klumpum.

[00:38:13.22] John Schwartz Jacobsen: Og hvør segði tú fekk--

[00:38:15.21] Allan Nolsøe: Tað er Heilsutrygd, ella Sjúkrakassin sum veitur stuðul.

[00:38:24.26] John Schwartz Jacobsen: So tað er stórt sæð Landið sum biður um tað, í síðsta enda.

[00:38:29.09] Allan Nolsøe: Tað er jú hagtøl sum vit geva teimum, so kunnu vit simulera hvørji upphæddir teir skulu brúka uppá hesu ymisku vørubólkarnir næstu ár. Alt eftir hvar fólk liggja í hesum skalanum, sum er so kompleks at eg skili ikki. Men vit hava eina skipan sum kann klára at gera hagtøl, sum fortelur Heilsutrygd hvat--

[00:38:58.24] John Schwartz Jacobsen: Tað er lógarkrav at tey hava atgongd?

[00:39:01.17] Allan Nolsøe: Nei nei, tey senda okkum ein fyrispurning, og so senda vit tað til tey.

...

[00:39:14.03] Allan Nolsøe: So leingi tað ikki er persónsdata, sum verður útflýggjaði, so váa vit at útflýggja tað, tí tað er ein partur av tí sum vit gera. Tí at Heilsutrygd, Apotekið og Sjúkrahúsið, tað er partur av tí sama (Landaogn). Tað er jú bara pengar sum--

[00:39:36.00] John Schwartz Jacobsen: Fer úr ein lumma til annan.

[00:39:38.25] Allan Nolsøe: Ja.

...

[00:40:36.09] Allan Nolsøe: Also, vit eru ikki integreraðir meira við leverandørar enn, man kann siga, í gammeldags traditionellan forstand. Vit eru ikki horisontalt ella vertikalt integreraði, hvar ið teir t.d., høvdu bara stýrt okkara disponering. Eg veit at teir gera tað niðri, og at teir dáma tað væl, tí at tað ger jú at kundin hevur nógv verri við at skifta leverandør. Man kann altíð argumentera fyri, at kundin sparir manpower uppá logistisk, men tað stutta av tí langa er, at tú sum kundi hevur nógv verri við at skula skifta leverandør vissi tú ert ónøgdur.

...

[Forstýra av kollega]

...

[Forkláring um consumer transparency]

[00:50:27.23] John Schwartz Jacobsen: Innanfyri farmaceuta-verðina, er tað nakað sum er tilsvarandi til tað?

[00:50:44.28] Allan Nolsøe: Tá tað kemur til apoteksdriftina, so brúka vit ISO-certifisering, fyri at vísa at vit arbeiða eftir--

[00:50:53.06] John Schwartz Jacobsen: Sovornum og sovornum mannagerðir?

[00:50:54.28] Allan Nolsøe: Ja, sum ger at okkara arbeiði hevur ein vissan standard.

...

[00:51:06.06] Allan Nolsøe: Vit eru í eina serstøðu í Føroyum, tí at hava monopol, og at Landsapotekarin eisini er mynduleiki á økinum. T.v.s., at vit egentliga bestemma um alt er gott nok. Men tá tað kemur til

framleiðsluna, so hava vit hetta her certifikat [peikar til eitt certificat á vegginum], sum er eitt EU-certifikat, sum ger at vit kunnu framleiða á sama høga standard sum ein og hvør onnur medicin framleiðari ger í EU.

...

Elin Mouritsen

Interviewer: John Schwartz Jacobsen

Interviewee: Elin Mouritsen

Date: 30-12-2016

[00:00:48.26] Elin Mouritsen: Tá vit innganga eitt sovorit samstarv, so spyrja vit "hava vit fingið certifikat av GDP-Compliance of a wholesale distributor. Og tað er so Sundhedsstyrelsen sum hevur blástemplað tað. Og tað er so fyri at tryggja okkum at vit ikki keypa eitt hvørt produkt; at tað er góðska í tí og at vit kunnu vita okkum trygg at tað er eisini tað vøruna vit eisini hava biði um. So har innskriva vit ein sáttmála, og eisini eina service-level agreement avtalu, og so hava vit fyrireika okkum certifikatið.

[00:01:35.07] Elin Mouritsen: So tað er sjálvandi fyri at tryggja okkum gjøgnumskyggi allan vegin ígjøgnum, so vítt møguligt.

[00:01:43.16] John Schwartz Jacobsen: So tann sum tit keypa frá, hann uppiheldur ein vissan standard.

[00:01:50.00] Elin Mouritsen: Ja. Og tað er hetta við forfalskning av--

[00:01:55.01] John Schwartz Jacobsen: Millum annað--

[00:01:56.09] Elin Mouritsen: Ja.

[00:02:02.11] John Schwartz Jacobsen: Hvat við logistik? Hava tit nakran serligan avtala við teir sum frakta medisini ella er tað bara ein vanlig avtala?

[00:02:12.12] Elin Mouritsen: T.d., so hava vit Nomeco, sum er tann størsti veitarin. Har er tað Nomeco sjálvt sum stendur fyri fraktini til Føroyar, og so skulu vit bara tryggja frá kajkantinum og niðan. Og har skal man vísa á, at tað er uppbevara rætt allan vegin. Og aftur har eru tað GDP reglarnir, sum teir skulu yvirhalda. Og eisini hava vit Amgros, teir standa eisini fyri fragtina inntil tað kemur hertil; teir hava gjørt tað avtaluna. Og har eru loggar á, og tryggja sær at tað eru fraktfirma sum eru góðkend til at transportera heilivág. Og tað er aftur GDP.

[00:03:12.23] John Schwartz Jacobsen: Hvussu langt aftur hugsa tit at tykkara leverandørketa er? Hugsa tit bara til leverandørin og kundan sum tit nú hava? Leggja tit stóran dent á, at man kan hava gjøgnumskygni víðari niður eftir ketuna?

[00:03:33.22] Elin Mouritsen: Tað er tað sum vit tryggja okkum við, at so vítt sum vit kunnu at teir hava pappírini í lagi. Og so kann man eisini snakkað um at, nú eru vit ISO-góðkend, so vit hava faktisk æltanir um í komandi árið, at fara út og eftirmeta. Gott nokk vísa tey eisini á her, at pappírini eru í lagið, men at gera tað sum man kallar ein audit. Og spyrja inn til mannagongdir; kunnu tey vísa okkum á hvussu tey gera tað. Og eg veit ikki hvar vit fara at vekta fyrst og fremst - vit hava snakka um Posta, t.d., at fara at hyggja eftir teimum--

[00:04:16.23] John Schwartz Jacobsen: Hvussu teir frakta tykkara vørur?

[00:04:18.24] Elin Mouritsen: Ja - er alt í lagi innanfyri tað.

[00:04:21.10] John Schwartz Jacobsen: Og er tað báðar vegir, altso til kundar hjá tykkum og frá leverandørin?

[00:04:25.09] Elin Mouritsen: Ja, altso vit hava ikki lýst ordiliga neyvt hvussu vit ætla at auditera, men vit ætla at hyggja eftir processina sum hon er. Og hetta hava vit eisini gjørt fyri nøkrum árum síðani. So trúgvi eg at man býtir tað upp í trinum, fyri at ikki gera tað ov stórt. So hyggir man út til kundan, og eisini hvussu fáa vit tað, vissi tað er okkurt niðrifrá. So man roynir allatíðina--

[00:04:54.08] John Schwartz Jacobsen: Syrgja fyri at alt er í lagið?

[00:04:55.11] Elin Mouritsen: Ja.

[00:05:03.05] Elin Mouritsen: Onkuntið er tað at vit skulu senda vørur retur. Vit fáa at vita at okkurt er galið við vøruni, og so hava vit eina mannagongd hvussu vit gera tað - vit hava eina leiðbeining, sum sigur hvør hevur ábyrgdina av at gera hvat og dokumentera at vit hava hugt eftir lagrinum - vit hava onki á lagrinum ella vit hava so og so nógv á lagrinum - og hava so kontakta Nomeco og tey fáa tað retur aftur.

--

[00:05:42.04] Elin Mouritsen: Men hetta kann vera at teir ikki yvirhalda eitt ella annað við vøruni - teir hava funnið útav at eitt firma ikki klárar at dokumentera okkurt, og so verður tað trekt aftur av marknaðinum, og so skullu vit eisini kunna vísa á at vit hava handla uppá tað og sent tað retur.

[00:09:56.01] John Schwartz Jacobsen: Nú vendi eg aftur til hetta at tit skulu tjekka hesa vørurnar út úr hesu her evropeisku skipanini. Heldur at tað verður tungt fyri tykkum, sum ein mannagongd at tit skulu registrera hvør einkult recept vøra, sum skal tjekkast út?

[00:10:14.23] Elin Mouritsen: Eg ímyndi mær ikki at tað verður. Vissi tað er ordiligt implementera, so er tað inni í skipanini. So er tað hon sum ger hesa logningarnir, og tískil er tað nærmast per automatik. Tí hetta krevur bæði sjálvandi nakað av KT-skipanini og at øll skanningin er í lagið. So kann eg ikki ímynda mær at tað er so tung process. Vit eru nokso von við at hava eftirlit frá enda til annan, at tað er naturligt.

[00:13:47.22] John Schwartz Jacobsen: GDP og certifikatir, tað er nakað sum tit hyggja nógv eftir? Tey bæði elementini eru knýtt nógv saman. Altso nakað tit hyggja eftir tá tit keypa frá nøkrum er, at teir yvirhalda hesi GDP-praksisirnar og at teir hava certifikatir?

[00:14:04.06] Elin Mouritsen: Ja, og faktiskt skalt tú eisini regluliga fara inn og hyggja at tað er uppdatera.

[00:14:25.08] Elin Mouritsen: Tað er meiningin at tú skal fara inn og hyggja eftir tí javnan.

[00:14:37.24] Elin Mouritsen: Altso Nomeco hava vit havt sum veitari í so ræðuliga langa tið. Vit skulu nokk vera betur eisini til at spyrja eftir hesum her GDP. Teir hava tað liggjandi, men vit skuldi eisini havt í okkara góðskuskipan. Tí tað sum eg hugsi nú kanska eisini at syrgja fyri at fáa alt inn í okkara góðskuskipan, soleiðis at vit kunnu vísa á vit hava regluliga hugt eftir tí. Og ikki bara tað at tað hevur verið ein álitandi partnari nú í longri tíð. Og alt er í lagi - tað vita vit at alt er í lagi hjá teimum - men vit skulu eisini kunna vísa á at vit hava tað skjalið liggjandi.

[00:15:20.18] John Schwartz Jacobsen: So man hevur sindur av hesum mentalitetinum "trust but verify"?

[00:15:26.19] Elin Mouritsen: Tað er ikki í lagið. Vit skulu inn javnan og spyrja tey um kunnu vit ikki síggja skjalið. Og hava tað liggjandi í okkara góðskuskipan, líkasum tá onkur kemur á skoðan og tað er ikki nøktandi at tit hava samstarvast við teimum í longri tíð, og man veit at tað hevur ikki verið nøkur problemir - tað eru teir sum veita runt í Keypmannahavn og aðrastaðnis í Danmark - men vit skulu eisini kunna vísa á at pappírini liggja har. Tað er tað sum vit skulu gera meira við.

[00:15:59.21] John Schwartz Jacobsen: Vit hava snakkað nógv um hetta her um hvat tað er sum tit hyggja eftir viðvíkjandi gjøgnumskygni. Nú kemur tann løgni spurningurin: Hvussu hyggja tit eftir tí? Altso nú hugsi eg um meira generelt: hyggja tit eftir einari heimasíðu, senda tit e-mail og biðja um dokumentatiónina--

[00:16:13.09] Elin Mouritsen: Vit skriva til veitarin og biðja um pappírini.

[00:16:27.17] Elin Mouritsen: Og tað er kanska har sum vit serliga hava verið góð, tað er hesi nýggju veitarnir sum vit hava fingið. Og kanska ikki hava verið líka góð við teir veitarnir, sum vit hava havt í longri tíð. Men nú tá vit taka smærri veitarir og sovrit, so tryggja vit okkum alvorliga at tingini eru í lagið. Nomeco eru so mikið stór, at har hava vit kanska ikki verið líka røsk til at biðja um pappírini.

[00:16:50.21] John Schwartz Jacobsen: Men har stóla tit eisini uppá teimum í vissan mun, eftirsum tit hava kent tey so leingi ella av tí at teir eru so stórir.

[00:16:58.19] Elin Mouritsen: Ja, akkurát.

[00:31:29.12] John Schwartz Jacobsen: Tú segði at tú kennir til VMI - altso Vendor Managed Inventory. Er tað nakað sum heldur at man hevði kunna brúkt her í Føroyum?

[00:31:41.11] Elin Mouritsen: Ja, har hava verið forskelligar avmarkingar, sum gera at vit ikki kunnu hava tað (VMI) her beint. Spurningurin er, eru vit KT-messiga (klár) ella hvat eru vit.

[00:32:00.05] John Schwartz Jacobsen: So tað kann antin vera KT ella okkurt annað, sum stendur fyri?

[00:32:03.19] Elin Mouritsen: Ja, eg dugi ikki ordiliga at svara tær - eg giti at tað er okkurt KT-messiga ella at okkara skipan skal eisini kunna snakka aftur til Nomeco, og ikki bara tað at vit fáa so sjálvdan vørur.

[00:32:45.00] Elin Mouritsen: Spurningurin er um tað vildi verið optimalt við okkara bíllegginar skipan. Tað kann vera at tað hevur rættiliga nógvar avmarkingar við tí at Niðri fáa tey jú vørur hvønn dag, og vit fáa eina ferð um vikuna. Um vit standa uppá nakað sum vit ikki ynskja ella um tað eru avmarkingar í KT, ella um tað er simpulthen okkara heila bíleggingaruppskot sum er so mikið øðrvísi.

[00:33:33.20] John Schwartz Jacobsen: Samarbeiði við leverandørketan. Hvussu nógv av tí heldur tú at apoteksverkið leggur í tað, at man samarbeiðir við alla leverandørketuna? Tit hava jú samarbeiði við læknarnir í Føroyum for eksempel, tí teir eru jú kundar hjá tykkum--

[00:33:55.07] Elin Mouritsen: Tað er absolut kundar hjá okkum

[00:33:59.09] John Schwartz Jacobsen: Og so er tað Nomeco for eksempel, sum leverandør. Hvussu nógv samarbeiði er ímillum tykkum? Er tað bara hetta vanliga við at tit keypa vørur, og tað er tað? Ella ferð tað út yvir tað eisini?

[00:34:09.05] Elin Mouritsen: Tað vil eg siga. Samstarvið við Nomeco er ógvuliga breitt. Vit kunnu hava fyrispurningar um alt møguligt til Nomeco innan øll trin í processina. Vit hava eitt dagligt samskiftið við Nomeco, vil eg nærmast siga. So har er samstarvið ógvuliga tætt.

[00:34:55.25] John Schwartz Jacobsen: Tú snakkaði um ISO? var tað ISO 9001?

[00:34:54.14] Elin Mouritsen: Ja.

[00:35:01.14] John Schwartz Jacobsen: Og forklára einum sum ikki veit hvat tað er?

[00:35:04.19] Elin Mouritsen: Tað er simpulthen at tryggja okkum at kvaliteturin er í lagið. At vit eru blivin certificeraði og at vit eru góðkent. Og við ISO 9001 gongur man øgiliga nógv eftir tí fakliga ráðgevingina og við alt innan veitan av heilivágið. Og tað er har serliga at fokus er ISO 9001. Vit hava leiðbeiningar, sum krevst innan tey ymsu økini, sum starvsfólk skulu vera kunnaði í, og vit skulu tryggja okkum at tey kenna til tær mannagongdirnar. Ja, tryggja kundunum hjá okkum at vit hava eina so mikið høga góðsku, soleiðis at tey fáa ta røttu vøruna við tí røttu kunningina innanfyri tí røttu tíðina.

[00:37:39.18] John Schwartz Jacobsen: Hava tit nakran form fyri track-and-trace á tykkara vørum, at tit kunnu fylgja hvar vøran fer? Bæði tá tit senda út og kunna fylgja við at vøran fer avstað? Ella frá veitarins síðu av, veitarin gevur tykkum møguleiki at fylgja vøruna næstan til hurðini?

[00:38:04.09] Elin Mouritsen: Eg veit at Posta fer at gera track-and-trace. Eg fái t.d., við vaksinurnar eitt track-and-trace nummar sum vit kunnu nýta. Men frá Nomeco, so er ikki nakað track-and-trace nummar sum vit fáa fyri at hyggja hvar vøran er komin í forløbinum.

[00:38:36.26] John Schwartz Jacobsen: So tit hyggja á vøruna, og hugsi eg ikki um track-and-trace men traceability, fylgja tit hvar vøran kemur frá?

[00:38:47.09] Elin Mouritsen: Ja, vit hava jú vøruna inni á okkara lagurskipan. Og har á er knýttur ein veitari, so tú sært altíð hvar vit fáa hesa vøruna frá.

[00:39:02.05] John Schwartz Jacobsen: Og tað er bara hartil og ikki longur aftur?

[00:39:06.00] Elin Mouritsen: Nei.

[00:39:06.20] John Schwartz Jacobsen: Tað at tey aktivu stoffini vera produsera frá hasum producentinum, sum verður blanda saman við ingrediensunum frá hasum producentunum.

[00:39:14.08] Elin Mouritsen: Tað síggi eg ikki í okkara skipan. So skal eg til at kontakta víðari út. Men tú hevur hesa vøruna sum hevur batch-nummar, so allir tær upplýsingar liggja eitt ella annað stað.

[00:39:30.24] John Schwartz Jacobsen: So man kann søkja eftir tí, uppá ein ella annan máta?

[00:39:33.20] Elin Mouritsen: Ja. Tá kanst tú væl kontakta firmaði sum hevur gjørt hesa vøruna, og so hevur tú eitt batch-nummar knýtt at vøruna, so kunnu teir finna allar upplýsingarnir um vøruna. So fer tað til Nomeco, og so liggur væl eisini har inni við einum batch-nummari, sum tey kunnu siga at henda vøran er flutt. Men nú konkluderi eg nøkur ting.