Towards Synthetic Vertical Integration

How Blockchain might reshape Supply Chain Integration in the fashion industry

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Abstract

Supply chain integration is a field that has been long studied to better understand how companies may improve their businesses. A broader supply chain integration has been traditionally linked to large or multi-national enterprises, who possess more resources and power to improve their supply chains, and pursue strategies such as vertical integration as means to gain a competitive advantage. However, emerging technologies have been enabling more companies of different sizes to pursue a deeper supply chain integration, although such integration remains very limited in small and medium enterprises.

This thesis investigates how an emerging technological trend (Blockchain) might impact the supply chain integration in fashion small and medium enterprises. Using an inductive approach, this paper builds upon qualitative data collected through a multiple case study. Three case companies were interviewed to provide a broader understanding of Blockchain's impact in SME supply chains today, and its potential impacts in the future.

The results indicate that Blockchain's impact in small and medium enterprises today is very limited in the fashion industry. However, with widespread adoption, the technology could eventually lead to decentralized networks across supply chains, which would enable a deeper supply chain integration for most actors, including SME. Such decentralized supply chain integration has been coined as a 'Synthetic Vertical Integration', as it could lead to very similar benefits as a vertically integrated supply chain.

This thesis argues that this process could potentially enhance the role of SME in the global economy and reduce some of the competitive advantage traditionally retained by larger enterprises. Finally, while acknowledging the important role of Blockchain in reshaping today's supply chains, this paper suggests that the emergence of Interoperability Systems (such as OriginTrail) could have more long-standing repercussions in the global supply chains. The author recommends that further research explore rather these systems could grow to become a general-purpose technology.

I'm always asking questions - not to find 'answers,' but to see where the questions lead. Dead ends sometimes? That's fine. New directions? Interesting. Great insights? Over-ambitious. A glimpse here and there? Perfect.

– Lesley Hazleton

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1 Introduction

Enterprises across industries have a long history with supply chain management. In the earlier part of the 20th century, most industries still operated local supply chains, where companies sourced most of their supplies from regional actors. However, this scenario began to shift significantly in the second half of the century.

In the past few decades, supply chain management grew in importance. Companies began to look at how they could make labor more efficient, and later at how they could make supply chain operations more efficient. With the rapid advancements of IT technology, companies of all sizes began to adopt different systems to improve their operations management, such as Enterprise Resource Planning (ERP) systems (Li & Liu, 2019). Amidst all that, global trading barriers lowered, and global supply chains became not only a reality, but a norm. Supply chain management thus evolved from simply optimization of local operations to a global strategy challenge. (Li & Liu, 2019; Vijayan et al., 2020)

Through this process, Supply Chain Integration (SCI) has been a widespread method of lowering costs and increasing efficiency for companies in almost every industry. As digitalization and globalization took the stage in the past decades, entire industries began requiring more integrated supply chains to solve stock redundancies and use tools such as Just-in-Time. (Vijayan et al., 2020). That has been particularly true for Multi-National Enterprises (MNE), which managed to explore such supply chain integration at a much deeper level. The concept of Vertical Integration emerged from this activity, whereby MNEs control or own their entire value chain. This concept has vastly changed the operations of supply chains, granting numerous benefits for these MNEs. With the advances of IT systems, these enterprises gained the ability to promote a much deeper level of information sharing.

However, such supply chain integration has been limited in SMEs due to their decentralized supply chain and limited resources. SCI for Small and Medium Enterprises continued to be a topic investigated by scholars, indicating that SMEs could integrate their supply chain at a deeper level, with many case studies arguing for its benefits. But the possibilities for integration are far smaller than what is observed in vertically integrated supply chains, and the gap between the literature and practitioners might be too big to bring any significant change. Thus, it becomes important to investigate how this gap can be breached, and how SME supply chains could be integrated despite the recurring difficulties. (Palomero & Chalmeta, 2014)

1.1 Background and Motivation

Upon its foundation, this thesis had deeper links to a startup project within the fashion industry. Throughout the project, it became very noticeable how SMEs in this industry are lagging behind in terms of supply chain efficiency, which was limiting the competitive advantage of these smaller actors. Particularly, the relations between retailers and brands seemed to be fairly inefficient, whereby a considerable waste of inventory was observed on the purchases and sales carried out by brands and retailers. Furthermore, the advances of digital transformation is beginning to shake the industry, making it necessary for smaller companies to adapt to the efficiency that is expected of them.

The project was eventually discontinued, but the issues identified in these actors – namely SMEs from the fashion industry – remained. Thus, the idea was born to evaluate how the advances in technology might reshape this industry, taking a particular look at how Supply Chain Management could be vastly improved in the small and medium enterprise environment. Such advances have the potential to change how these business run today, improving the overall operation of these small actors and perhaps even allowing them to rediscover their competitive advantage in the growing digital world.

The core idea of this thesis might be applicable for numerous industries. However, the focus on the fashion industry derives not only from to the background knowledge of the author. Firstly, the size of the fashion industry is huge, as it contributes to over USD 450 billion sales worldwide (B. Wang et al., 2020). It is also an industry where supply chain integration has been deeply explored for larger companies, and where some companies even rely in their supply chain integration to maintain a competitive advantage.

Finally, the fashion industry also seems to be in a key moment. Digital transformation, a core aspect in SCI, is beginning to gain speed and many startups are emerging to supply fashion brands with the tools they need to pursue digital sales. The consumer is also increasingly demanding more sustainable products, while sustainability remains one of the major challenges in the industry. Overall, the fashion industry appears to be filled with uncertainty, and it seems that new technologies could indeed reshape its outlook. It seems ideal to investigate the future of SCI.

1.2 Blockchain and Supply Chain Management

Blockchain is a technology with potential to disrupt several fields, including supply chain management. From a technical perspective, Blockchain is a simply a backend database with a distributed ledger – i.e. it does not have centralized data bank, but rather a decentralized one (Parikh, 2018).

The technology was initially created in the field of banking, to support the development of cryptocurrencies, contributing to solve major issues in transparency and creating a environment without the need of trust. Such solution for transparency could be applied in essentially any given industry, but the field of supply chain management stands to benefit a lot from greater transparency. Furthermore, it could enable greater solutions for this field, with potential improvements in supply chain visibility and perhaps even in integration.

The literature around blockchain has advanced a lot in recent years, and its application in supply chain management are numerous. Most often, it seems to be deeply linked to concepts such as traceability, or discussed as means of reducing waste and improving SCI. In fact, there are many researches exploring even the role of blockchain in fashion supply chains and how it could reshape this industry. These studies are, however, considerably new, with few papers around blockchain technology older than five years.

Furthermore, it seems that most studies look at the supply chains from a very general sense, discussing aspects such as fast-fashion, which applies mostly to LEs and MNEs. There seem to be a lack of studies that evaluate how the advances in blockchain technology could impact SMEs in the fashion industry, and which role it might play on reshaping supply chains. As blockchain has the potential to be a disruptive technology in the field of SCM, it becomes imperative to evaluate not only how it might impact operations on bigger actors, but also the impact it could have on smaller actors.

1.3 Purpose and Research Questions

Blockchain Technology (BCT) is quickly advancing as a technology with potential to disrupt many different markets. In Supply Chain Management, its application has been consistently growing to improve operations and punctual problems. Accordingly, the literature has been expanding to understand how Blockchain could impact supply chains. However, the literature remains somewhat limited when exploring how a widespread use of Blockchain could affect the overall Supply Chain Management. This becomes even more evident when exploring the role of Small and Medium Enterprises in a future with widespread BCT usage. The lack of research in this area provides a knowledge gap for the smaller actors in different industries, which might not become as engaged in the technology as the larger actors.

Furthermore, with a limited knowledge on how Blockchain will impact Small and Medium Enterprises, the overall understanding of BCT's impacts in the macroeconomic environment will consequently become more limited too. Thus, it is important to evaluate the role Blockchain might have in today's SME, and how it might affect them in the future.

The fashion industry, being an industry with global supply chains and massive importance in the world's economy, appears to have high potential for application of BCT. As previously explored, SMEs in this industry also suffer to compete with larger enterprises, particularly in their supply chain management, wherefore it becomes important to further investigate how they might be impacted by BCT. Thus, the fashion industry is an ideal choice for this paper to focus.

The purpose of this paper is *to investigate the role of Blockchain Technology in today's small and medium fashion brands, and explore the potential impacts that Blockchain might have in the future of the fashion supply chains.* This will be done through an inductive research, focusing on qualitative data. In order to fulfill the aforementioned purpose, the following research question will be addressed, with sub questions:

RQ1: *"How will Blockchain impact fashion Small and Medium Enterprise supply chains?"*

RQ2: "How is Blockchain perceived by fashion Small and Medium Enterprises today?"

2 Theoretical Background

2.1 Fashion Supply Chains

Supply chain management is well developed field, created to address operations in the internal and external environments of a company, so that its supply chain can become more efficient. In the fashion industry, supply chain management usually englobes everything from transformation of raw materials, until distribution and retail sales of final products. In today's globalized world, the fashion supply chains requires better organization, coordination, and communication across actors. Consumer demand increased the need for brands in the fashion industry to expand their product variety, while products in this industry also began to have shorter life cycles. As a consequence, the supply chains became better adapted to suit the consumer need for new products and short lead times, while the complexity of these supply chains also become significantly high. (Camargo et al., 2020)

Such new approach to supply chain management in the fashion industry, with very short lead times, created the concept of 'fast fashion'. Fast fashion refers to companies delivering the newest trends to the front stores with a lead time of around five to six weeks. Such concept is predominant in fashion multinationals (MNE), such as H&M or Zara, due to their strong supply chain capabilities. These companies can be considered vertically integrated – Zara owns its supply chain from manufacturers to retailers, while H&M has a lot of control over its supply chain – wherefore they can maintain very agile and efficient supply chains, minimizing their inventory and speeding up the lead times. (Camargo et al., 2020)

However, despite the fact that fast-fashion requires efficient supply chains to operate, certain issues still arise. One key problem is that the fast-fashion approach is by definition not very sustainable. It is linked to shorter product life cycles, which increases the generation of waste. Guo et al. (2020) suggests that, in line with the issues with overproduction and surplus stock in the industry, over 87% of the clothing fiber ends up either incinerated or buried in landfills.

Another problem arising in such linear supply chains is that the information regarding customer demand is often distorted as it goes upstream of the supply chain – mostly because suppliers need to keep a buffer. This creates the so-called bullwhip effect. The bullwhip effect means that production upstream of the supply chain is larger than the actual demand, in order to cover for errors and spikes. However, as MNEs tend to have a high degree of supply chain integration,

they are capable of minimizing the harms of the bullwhip effect by centralizing the information regarding consumer demand. (B. Wang et al., 2020)

Looking at SMEs, the perception becomes considerably different. As fast-fashion requires efficient supply chains with short lead times, it is already a far more difficult approach for SMEs to consider. With considerably lower supply chain integration, their capability to hold up to very short lead times, whilst minimizing the bullwhip, is very limited. Thereby, we can assume that such approach has been limited to LE and MNEs, in their effort to gain competitive advantage. Many of these concepts are further explored in the coming sections.

2.2 Supply Chain Integration

The advances of globalization and lower trading barriers around the world has entirely changed the outlook of supply chains. Today, many supply chains became global, with complex networks that involve numerous actors around the world. This has driven down costs and helped companies to improve their competitive advantage. But the management of these supply chains became extremely complex, wherefore it is hard to keep them efficient. In order to meet the market demands, companies now require their supply chains integrated in the highest order. (Vijayan et al., 2020)

Palomero and Chalmeta (2014) define the core of Supply Chain Integration (SCI) as "aligning and coordinating the resources, decisions, methods, business processes and employees of the different stakeholders in the supply chain to improve their ability to work together in a continuous improvement process". (p. 1)

The benefits of a deeper Supply Chain Integration are numerous. B. Wang, Childerhouse,, Yuanfei, Baofeng and Mathrani (2016) argue that SCI can increase the performance by reduction waste and duplication, as well as a more effective management of the value chain. This includes better interface management, trade-offs and decisions reaching a wider range.

In the pursuit of SCI, many strategic initiatives were developed, such as vertical and horizontal integration. Vertical integration regards the streamlining the supply chain in a vertical sense, focusing on suppliers and customers. Horizontal integration, on the other hand, aims to streamline the supply chain in the same level as the 'main company', i.e. by acquisition of

competitors. These methods have been great to address supply chain integration and efficiency, helping companies to improve their competitive advantage. However, as both vertical and horizontal integration involve companies expanding their control or ownership over a supply chain, they are often linked to the appearance of monopolies or oligopolies in the market. (Vijayan et al., 2020)

2.2.1 Content-based SCI Dimensions

The literature over Supply Chain Integration has greatly expanded over the past decades, where SCI has been traditionally investigated through three different dimensions, namely internal integration, supplier integration and external integration. This approach had great success to investigate the different scopes of SCI, and provide a focus on the internal or external relationships where the focus of SCI lies. (B. Wang et al., 2016)

However, this scope-based approach suffers from many shortcomings, particularly in order to observe SCI system as a whole. A new approach proposed by B. Wang et al. (2016) focuses instead on the content of Supply Chain Integration, looking over different dimensions that allow researchers to get such a holistic perspective. The three content-based dimensions explored in the study are: (1) Strategic Alliance; (2) Information Sharing; and (3) Process Coordination.

(1) Strategic alliance refers to a relationship between a buyer and a supplier that "facilitates the exchange, sharing, or co-development of resources or capabilities to achieve mutually benefits" (B. Wang et al., 2016, p. 841) . Such strategic alliance is viewed as necessary to maximize the efficiency of flows. This allows the different member of a supply chain to share objectives, which would otherwise be a roadblock in the pursuit of SCI.

On an operational perspective, supply chain management is generally focused on the flow goods and information surrounding those goods. In the context of integrating a supply chain to improve its efficiency, it becomes paramount to share information across the entire supply chain and relevant stakeholders, as well as coordinating all the processes involved in the supply chain. Hence, the two other dimensions of this content-based approach to SCI, (2) Information Sharing and (3) Process coordination.

2.2.2 SCI in Small and Medium Enterprises

Pursuing such Supply Chain Integration capability in SMEs might be far more complex than for larger corporations. B. Wang (2016) suggests that, amidst different enablers for SCI, Inter-organizational factors, such as trust, commitment and power, are considered crucial features for supply chain excellence. The author further argues that powerful firms will often play a more important role in SCI than less powerful ones.

Logically, with less resources, smaller companies possess less power over their supply chains. Thus, their role in pushing for a supply chain integration becomes more limited. The literature reflects that, where most of the studies are dedicated for MNE or LE. The advances regarding supply chain integration in SMEs, regardless of the industry, have been very limited. (Palomero and Chalmeta 2014)

As presented, SCI presents numerous benefits for firms along the supply chain, such as reduced costs and increased efficiency. However, in SMEs, the need for SCI might not be internally driven in pursuit of these benefits. In many cases, external stakeholders that might push for SCI, such as large corporations that exist in the same supply chain. The external environment, including shifts in economy's dynamics, could also drive SMEs into SCI as means of survival.

Simply put, too many factors in the world economy are requiring more efficient supply chains, not only for large actors but also for small ones. Companies that do not attempt to build more efficient supply chains might become victims to the competitive advantage imposed by LEs and MNEs. (Palomero and Chalmeta 2014)

2.2.3 Vertical Integration

Vertical Integration (VI) is a strategy firms use to gain control over their supply chain. Different actors in the supply chain can come together to standardize methods and procedures, so that their supply chain can reduce costs and maximize the efficiency. Furthermore, this can allow companies to have more secure distribution channels, and even improve their sustainability. (Vijayan et al., 2020)

While in the past vertical integration had been predominantly characterized by one company holding full financial ownership of multiple actors in a supply chain, such definition has changed significantly with the development of new VI theory. Today, VI incorporates not only integration through ownership, but also with other means of control over the supply chain

(Harrigan, 1985; Mahoney, 1992). In particular, an alternative to vertical financial ownership appears in vertical contracting – through exclusive sales, exclusive territories, etc. – which allows firms to pursue similar benefits of vertical integration. While its benefits might not be as extensive as those of financial ownership, the requirements are significant lower (Mahoney, 1992). Furthermore, it pursues the idea that supply chain integration does not require financial ownership, but that other deals and collaborations between actors could also generate similar benefits. Such integration, however, still appears to be limited to firms that can exert influence over other actors in its supply chains, such as LE or MNE.

Generally, VI can be divided into two main types: Forward Integration and Backward Integration. The former refers to integrating actors downstream of the firms supply chain. This strategy allows companies to secure their sales channels, whereby they can achieve higher economies of scale, as well as gain more market share. Backward integration, on the other hand, refers to integrating the actors upstream of the firms supply chain. Such strategy allows firms to secure resources and create more efficient supply networks. There is also the case of companies that pursue a balanced integration, having a mix of backward and forward integration. (Vijayan et al., 2020)

There are several advantages and disadvantages of VI. Firms can lower their transactions cost, reduce the uncertainty in the supply chain, gain more strategic independence, improve their positioning against competition, and synchronize their supply and demand. Waste can be drastically reduced, making the supply chain much more efficient. However, it can also lead to difficulties for management to handle the new activities, lower flexibility in the supply chain, more rigidness on the organizational structure, and even risk losing any advantage if VI is poorly managed. (Vijayan et al., 2020)

In the past decades, vertical integration was revolutionized by the advances in IT systems. Many aspects regarding the complexity of managing supply chains became simpler with the development of technologies such as Enterprise Resource Planning. Communication and collaboration that were already facilitated by Electronic Data Interchange, became much simpler and encompassing far more actors as the internet expanded (Patro & Raghunath, 2020). IT systems became the key to reduce costs and increase efficiency in supply chains, permitting improvements in transactions, coordination, and forecasting (Patro & Raghunath 2020). Aspects of IT systems within Supply Chain Management are further discussed in the following sections.

2.2.4 Horizontal Integration

Horizontal Integration (HI) most often refers to the acquisition or control of actors working in the same level of the supply chain, such as competitors. It often carries a bad connotation where companies integrated their supply chains by taking over – forcefully or not – or merging with their competitors. As the company grows horizontally, it becomes easier to pursue economies of scale, product differentiation, new market entry, and even to use their power to influence other actors across the supply chain. (Vijayan et al., 2020)

Such increase in the market share will often lead to monopolies or oligopolies, which tend to cause severe damages to the industry. For this reason, most strategies that are used for horizontal integration, such as mergers or takeovers, are carefully monitored by regulatory agencies, being subject to strong antitrust laws. Thus, the value of HI will highly depend on government support and the market conditions. (Vijayan et al., 2020)

Overall, horizontal integration has many benefits, such as economies of scale, product differentiation, increased market power, reduced competition, and improved supply chain flexibility. However, these benefits are often achieved through monopoly or oligopoly in the market, which is heavily discouraged and regulated by governments. (Vijayan et al., 2020)

2.2.5 Traceability and Sustainability

Another distinct strategy within SCI that has gained a lot of attention in recent years is the concept of traceability. It regards the ability to identify and trace products across their supply chain, being able to track them back to their origins. It is often associated to sustainable supply chain management, as it allows us to verify the actors that involved in the creation of the product, and thereby ensure that the companies are following their claims in terms of social, environmental, and even economic sustainability. (Vijayan et al., 2020)

Traceability is a particularly important concept to address sustainability questions in the fashion industry, in terms of pursuing sustainability. The industry has proven to be one of the most harmful in terms of sustainability, and demand is quickly beginning to push for more sustainable products. (Guo et al., 2020; M. Wang et al., 2020). Observably, multinationals such as C&A or H&M are responding to the demand by providing more sustainable products, and marking which collections are sustainable. Furthermore the industry is also plagued by overproduction and surplus stock (Guo et al., 2020). In such an environment where

sustainability is not particularly observable to the consumer, further ‘proof of sustainability’ is somewhat required. Thereby, traceability becomes an essential tool to verify the origin of resources.

To pursue traceability across the supply chain it is necessary to make different stakeholders collaborate and integrate their traceability systems. Doing so can help both tracking and mapping the value chain. Understanding the flow of resources across the supply chain allows decision-makers to understand the advantages and disadvantages of certain supply chain designs, leading to better strategies to improve the efficiency. (Vijayan et al., 2020)

Many obstacles stand in the way of achieving traceability across a supply chain. Firstly, the supply chain complexity makes it very difficult to trace a product along a supply chain, which in turn leads to fewer products being traceable. To go around such issues, it is necessary to implement very high investments to overcome the technological limitations existing in the supply chain. Such process becomes very difficult for smaller firms and actors upstream of the supply chain (Vijayan et al., 2020).

Many of the aforementioned challenges inherent to implementation of traceability, could be overcome with the development of new technology. While traditional IT systems can already simplify a lot of these processes, in most cases they are not enough to overcome the supply chain complexity. However, the emerging Blockchain technology could reshape the entire application of traceability, and overcome the issues hereby described. Guo et al. (2020) argues that “among various advanced information technologies, blockchain represents a state-of-the-art technology for enabling traceability” (p. 3). The use of this technology and its role in promoting supply chain traceability and visibility are further discussed in section 2.4.1.

2.3 IT Systems in SCM

The area of supply chain management (SCM) regards the integration of different processes within and outside the boundaries of a business, incorporating stakeholders across the supply chain, from suppliers until the end user. With globalization, supply chains grew more complex, whereby the advances of technologies, particularly information technology (IT), gained the key role of simplifying its management. Sousa et al. (2020) elaborates on the use of IT in SCM:

“The main purposes of implementing technologies in supply chains are the reduction of operational costs, the improvement of operational performance, the improvement of customer satisfaction the reduction of inventory levels and the reduction of lead-time. Technologies which integrate different areas and promote collaboration make possible improvements in information sharing and improve efficiency in supply chain activities.” (p. 612)

Patro and Raghunath (2020) divides the role of IT in SCM can be divided in three categories:

(1) Transaction Execution: regards the use of IT within transactions between companies, such as order processing, billing, dispatch advises, and etc. This type of IT systems are essential for increasing efficiency of transactions within supply chains.

(2) Collaboration and Coordination: regards using IT to share data regarding inventory management, such as demand forecasts, production information, and other aspects related to planning. It also includes data on individual orders, thereby contributing to tracking of products and parts. This type of IT systems aim to increase the efficiency of the supply chain.

(3) Decision Support Systems: regards using IT systems with great analytical power to help management with decision making. It can involve data from operations across the supply chain, which will ultimately help decision makers with more precise forecasts and etc. It can vastly improve the strategic management of the supply chain.

Several IT tools have existed in supply chain management for a long time. A major technology that has impacted companies in the past decades has been Enterprise Resource Planning (ERP) system. These are systems implemented across an entire company that automates all activities in the business. They allow all data from the business to be gathered in one place, connecting all different activities and areas of the business such as inventory, finances, orders and etc. While ERP systems can bring immense improvements to supply chain efficiency, its implementation is quite costly and bring vast changes to the organization and its surrounding culture. Furthermore, these tools will often require certain customization and training in order to be well adapted to the organization. (Patro & Raghunath, 2020)

2.3.1 Industry 4.0

In recent years, major trends in technology have also been encompassed under the banner of Industry 4.0, or the ‘fourth industrial revolution’. The term comes from advancements and disruptions that have been occurring in the industrial sector in the past years, essentially addressing a shift from a ‘machine dominant manufacturing’ to a ‘digital manufacturing’. Koh, Orzes & Jia, 2019).

Three major paradigms have been used to define Industry 4.0, namely smart products, smart machine and augmented operator. Smart products refers to machines and objects carrying microchips and sensors that are ruled by software. Smart machine refers to devices utilizing ‘machine-to-machine’ technologies or cognitive computing technologies, including AI and machine learning. Finally augmented operator refers to the available technological support for the operators in the production line, where modularity and flexibility play a major role. Following these paradigms, researchers developed six principles for the implementation of industry 4.0. These principles are: Interoperability; virtualization; decentralization; real-time capability; service orientation and modularity. A few of the main technologies driving these changes are explored bellow. (Koh et al., 2019).

2.3.1.1 Technologies

Internet of Things (IoT): This is a technology that refers to a network of objects equipped with sensors, software and etc., which purposefully connect and exchange data with other devices through the internet. The technology can contribute to combining intelligent machines, human and machine interactions, advanced predictive analytics, among other things. It is a majorly important technology for supporting smart factories. (Koh et al., 2019)

Big Data Analytics: Companies have increasingly invested in their capability of big data analytics, improving their algorithms development and data interpretation. This field can greatly contribute to improving data collection, real-time data analysis and decision-making. It can further be used for failure detection and predictive analytics. (Koh et al., 2019)

Cloud Computing: Cloud computing centers usually store and compute vast amounts of data and can contribute to complex decision-making, higher performance and lower costs for the organization. It enables service-orientation and modularization in manufacturing, two design principles for industry 4.0, being a vital technology for a its implementation. (Koh et al., 2019)

2.4 Blockchain Technology

Blockchain technology is a major trend that is disrupting many fields of technology. The definition of Blockchain Technology (BCT) is most easily derived from its etymology, literally a chain of blocks, where each block refers to a data structure (Voronchenko, 2017). On a more technical sense it is a backend database with a distributed ledger. This means a database that is decentralized and distributed. In the case of an enterprise, it could encompass the bookkeeping of companies across a supply chain, for example. (Parikh, 2018)

Blockchain allows companies to record transactions without needing a central authority, while assuring the security of such transactions. It allows all member of a blockchain network to access a shared ledger of information where the transactions are recorded. Thus BCT enables secured transactions and data sharing. Furthermore, the governing of these networks can forego from a democratic setting, where voting can be established for each actor in the network. (Voronchenko, 2017; Parikh, 2018)

In the sense of Supply Chain Integration (SCI), blockchain technology seems to be a nearly disruptive technology, carrying the potential to drastically change the outlook of supply chains and the pursuit for SCI. Despite that, the number of relevant studies in this area is very limited (M. Wang et al., 2020). Nonetheless, BCT often supports SCI in the literature, by promoting information sharing, traceability, and automation in digital transformation, wherefore it is positively related to SCI aspects such as supply chain flexibility, agility, and visibility (M. Wang et al., 2020). This can help to tackle some major issues in fashion supply chains, as explored below.

2.4.1 BCT - Traceability

In supply chain management, some major concerns surround the lack of visibility and existing information asymmetry. These issues are often linked to the previously explored concept of traceability, which envisions a clearer supply chain where it is possible to track products and their components and materials back to the original source. As discussed, several authors argue for the importance of blockchain to address traceability, being even named a ‘state-of-the-art’ technology to pursue such strategy (Guo et al., 2020; M. Wang et al., 2020).

As blockchain technology is implemented, data sharing from most actors become easily available. This can help supply chain members, such as the consumer, to increase its visibility

of the supply chain and even track the origin of certain products back to the raw material (B. Wang et al., 2020).

Furthermore, in the fashion industry, the environmental quality of a product – hereby defined as the amount of eco-friendly material – cannot be observed by the consumer, making it necessary for brands to place eco-labels on the product (Guo et al., 2020). In these cases, the labels can only be trusted by the brand's credibility. BCT offers the possibility for customers to track the sources of the materials used, making it a more reliable system to verify the environmental (and even social) quality of a product.

2.4.2 BCT - Bullwhip Effect

As previously addressed, the fashion industry has serious with overproduction and surplus stocks (Guo et al., 2020). As most supply chains in this industry are linear, the information regarding demand from the end customer becomes distorted (B. Wang et al., 2020). This is particularly true in supply chains with low level of collaboration and integration, as it often is the case in SME supply chains. That causes the so-called Bullwhip Effect, where the forecasted consumer demand is amplified upstream of the supply chain.

Blockchain technology can create a decentralized network that allows sharing of asset database. It allows a supply chain to grow its data exchange in scale, with speed and security, incorporating all actors while removing the need for building trust between them. The magnitude of the data sharing and collaboration prospects, enable these supply chain actors to create more accurate forecasts, minimizing the bullwhip effect in pre-production stages. But it can even improve the production stage and transit processes. B. Wang et al. (2020) argues:

"Blockchain technology can help to reduce fraud and errors, reduce the time, costs, and waste of fashion products in the transit process, and remove the need for double verifications, all of which, in turn, reduces the inventory amount of production and related packaging throughout the whole fast-fashion supply chain" (p. 5).

Thus, while overproduction and the bullwhip effect were traditionally tackled by centralizing information, for example through vertical integration, such strategy appears to be less relevant with the advances of BCT. This new technology is able to vastly increase information sharing through the supply chain, and improve its integration, while promoting a decentralized and trust-free structure.

2.4.3 BCT – A General Purpose Technology?

Due to the vast potential applications for Blockchain Technology, it is often discussed rather the technology fits the role of a General-Purpose Technology (GPT). A General- Purpose Technology is a technology that can affect the entire economy, often holding deep impacts in the society and perhaps even reshaping the economy. The technology is usually adopted by several or even all market segments, leading even to the development of other technologies around it. Simple examples of such technology are the wheel or electricity. (Kane, 2017)

Kane (2017) explores the defining characteristics of GPT, namely (1) the technology's ability to improve; (2) wide penetration of market; and (3) spin-offs to other technologies. The author moves on to argue that Blockchain technology has the potential to lead to all of these three defining characteristics, whereby it can be seen as an emerging General-Purpose Technology, rather than an incremental technology. However, there are several difficulties and limitations in attempting to identify a GPT at such an early stage, wherefore the results remain somewhat speculative. BCT should nonetheless be treated as a technology with potential to become a GPT. (Kane, 2017)

3 Research Methodology

3.1 Research Design

The aim of this research is to investigate how Blockchain Technology (BCT) is impacting small and medium fashion enterprises today, and how it might impact the industry in the future. As there is a lack of research in this field, this paper uses the data gathered from the field to formulate new theories in the process of answering the research questions. Thereby, the reasoning used in this thesis must adhere to an inductive approach, where the observation and findings will be used to formulate a theory rather than testing one.

The data required to address the research question is of a qualitative nature. The formulation of this new concept requires analyzing abstract data, which is intuitively descriptive. Such complexity makes the data unquantifiable at this point, wherefore this paper will be working with a qualitative research approach. Such approach is more suitable for an inductive research, as quantitative data is better suited for testing theories rather than formulating them. The current research strategy would necessarily be a Inductivist Qualitative research, as it is necessary to begin by observing the existing systems to identify the patterns in them, and later consider how this theory might be formulated. Being a complex and abstract area, it is imperative to focus on qualitative data for the time being. (Bell, Bryman & Harley, 2018)

Such an inductive and qualitative approach to this thesis also allows it to be more flexible and adaptable according to the data collected. Thereby, this paper follows an iterative process, where the theory explored in the literature review was used to formulate the data collection process, where in turn the data collected also impacted the literature explored in the theoretical background. This iterative process is further explored in chapter 3.3.

Both research questions target the same actors, but the data necessary to address each question is somewhat different. RQ1 aims to investigate the current situation of fashion SMEs in relation to Blockchain Technology. To answer this question, it is necessary to explain the current behavior of these specific actors in the industry, particularly in relation to the technology. Therefore, it regards gathering data from the industry's perspective on Blockchain, looking at today's scenario and gathering real-world data.

On the other hand, RQ2 aims to investigate the potential impacts that Blockchain might have on fashion SME. It addresses a future scenario, involving speculation on how Blockchain might affect the industry. It regards gathering data from experts in both BCT and Supply Chain Management, regarding how they see that the industry may be impacted by the technology and its future prospects. Thus, to address these different research questions, this thesis will need to gather data from three different perspectives: (1) Industry Perspective; (2) Blockchain Perspective; and (3) Supply Chain Management Perspective. This approach allows the same technology and industry to be viewed from different perspectives, being therefore a type of triangulation, an aspect further explored in chapter 3.5. (Triangulation, 2014)

3.2 Research Method

This paper will investigate the current behavior of SMEs in the fashion industry, and try to gather how they will be impacted by a new technology advancing in Supply Chain Management. Thus, it will be necessary to collect highly descriptive data to better understand the current and possible future scenarios for the industry. Such focus on deep and highly descriptive data can most easily be gained by using a case study. Case studies are most suitable to understand the complexity and nature of a specific case.

As argued, this thesis will require data from three different perspectives to answer the research questions – namely an (1) Industry Perspective, an (2) Blockchain Perspective and a (3) Supply Chain Management Perspective. Accordingly, a single case study becomes inviable, as it would not allow such different types of data to be gathered. Instead, the method used in this research will be a multiple case study.

Firstly, to address the Industry Perspective, this paper requires deeper data on how fashion SMEs perceive Blockchain and to understand the behavior of this target group. In order to acquire enough data directly from SMEs to create generalizable conclusions, it would be necessary to gather a great number of case companies. As resource and time constraints apply, gathering data directly from SMEs is not viable. Instead, a secondary choice is to gather data from a company with deep knowledge in the field, a so-called ‘industry specialist’. As Blockchain refers to an Information Technology, it would also be preferable to collect data on from the Industry Perspective, of an actor with specific knowledge in the IT aspects of the field.

Thus, the first case study targets a company that can provide an industry perspective over Blockchain. The actor is ideally a service provider that attends to the needs of multiple small and medium enterprises in the fashion industry, while also holding a deep knowledge on these companies' IT needs. Thereby, this actor also holds a deep knowledge on how new IT technologies (such as Blockchain) are impacting fashion companies, and what are the trends in the industry.

Secondly, to address a Blockchain Perspective, the most logical procedure for gathering data would be to conduct such investigation with a company providing services through this technology. Such actor would be capable of providing a deep knowledge on the technology, but also describe how it is impacting the market today, and what is their vision for the future of the technology. The company would be a so-called 'blockchain specialist'.

Therefore, the second case study aims for a company that provides a service based on Blockchain and targeting the fashion industry. Such company holds a deep knowledge on how BCT is applied today, on how the technology works, and on how it might impact the entire industry in the future.

Finally, to address a Supply Chain Management Perspective, the goal remains to observe the role of the emerging technologies in supply chains, and how the field will be reshaped by them. Thus, it is necessary to collect data from a holistic perspective, observing how multiple technologies are affecting supply chains, albeit maintaining a focus in BCT. The ideal interviewee would be a company working with innovation in supply chains from such a holistic perspective, namely a 'supply chain specialist'.

Thereby, the third case study aims for a company working with innovation in SCM, with close links to research in the field and innovative solutions. It is also ideal that this company has connection to current supply chain solutions, as well as emerging ones, providing a holistic view as to how supply chains look today, the main technologies changing them, and what the role of Blockchain is.

Through this careful approach, this paper should successfully collect data from the three different perspectives mentioned here. This data should bring a comprehensive view over how Blockchain and other technologies are impacting the field today, and how it might impact in the future, therefore addressing the research questions and the overall purpose of this study. Certain limitations to the research do apply, and will be further explored in chapter 3.5.

3.3 Empirical Data Collection

This study is following an inductivist qualitative approach, which aims to collect highly descriptive data. While using a multiple case study method, each case study aims to answer a specific research question. Thus, slightly different methods for collecting the empirical data in each case study should contribute to answering the different research questions more accurately. On all three case studies the data will be collected through interviews. Interviews are the best method to gather data in this inductive approach, allowing a great amount of descriptive data to be gathered. As this research will gather data from three different perspectives, there is a need to design different interview guides for each case study. Furthermore, due to the inductive nature of this research, the empirical data collection followed an iterative process that further helped to design the interview guide, as well as the literature proposed.

3.3.1 Iterative Process

In accordance with the inductive nature of this thesis, the data collection followed an iterative process. Firstly, a structured literature review was conducted, gathering some data and knowledge in the field of study – supply chain manamgent and blockchain – and thereby helping to structure the methodology section. This initial knowledge was used to build a first interview guide, which targeted case study of a Blockchain Specialist. The interview guide was used in the first interview carried with the company, allowing a vast amount of data to be gathered, as well as providing better understanding of concepts of importance in the literature.

This first interview served as a pilot, and permitted a better design of the following interviews in both case studies. The specific knowledge in BCT and what areas are of interest, allowed the formulation of a better interview guide for the Industry Specialist, approaching specific areas of the industry that are impacted by Blockchain. Furthermore, it allowed for a better iteration of the interview guide used with the second interviewee of the Blockchain Specialist case company, and as a foundation for the interview with a Supply chain Management Specialist. Following the second and third round of interviews, certain knowledge gaps were observed in the theoretical background of this research. Such gaps could limit the analysis conducted in this paper, as well as limit the understanding of the field to the reader. Thereby, a secondary literature review was conducted based on the data gathered. Thereby, this thesis was built through a highly iterative process, where the data collected had impacts both in the design of the interviews, and the literature reviewed for the theoretical background.

3.3.2 Interview Guide – Industry Specialists

The interview guide for the Industry specialists had a focus on the company's current operations, their involvement in SCM activities and services, and the company's perspective over Blockchain. The overarching goal behind this structure was to define how the market is behaving, or rather to perceive how a standard IT company in the market is reacting to the changes impacted by Blockchain.

This interview was also carried following Fitzpatrick (2013) principles for business interviews, and in a semi-structured manner. Follow-up questions will also be developed through the interview. Furthermore, the interview questionnaire was developed according to theory found in the theoretical background, as well as to industry aspects discovered in the pilot interview. Said interview contributed to developing more straightforward questions around Blockchain and its role for fashion SMEs. The interview questionnaire can be found in Appendix 3.

3.3.3 Interview Guide – Blockchain Specialists

The interview guide for the Blockchain provider aimed to answer the most technical side of the research questions, as well as to explore the potential impacts of Blockchain. This is due to the fact that the Industry Specialist might have limited knowledge on how BCT works, its role today and how it might reshape the future of supply chains. Thus gathering this data form actors that are already working with its implementation is highly preferrable. The Blockchain Specialist should preferably have knowledge targeting the fashion industry, although general knowledge around BCT is also acceptable.

Following Fitzpatrick (2013) principles for business interviews, the first questions will be presented very broadly, and the interview will be conducted in a semi-structured manner. Follow-up questions will also be developed through the interview, according to the responses given by the interviewee, which will help to explore new areas.

The initial interview questionnaire can be found in Appendix 1. The first interview conducted with this interview guide gathered a lot of valuable data, but also contributed to narrowing the scope of the interview and restructuring the questions of interest. The second iteration of the interview questionnaire for Blockchain providers can be found on Appendix 2.

The first goal of these interviews was to get the practitioner's perspective on how BCT will impact supply chain management in the future. Secondly, it was intended to understand how these impacts could be perceived in the context of the fashion industry. Thirdly, the interview intended to gather data on how the company is currently operating and how the Blockchain market is currently developing. Finally, questions regarding SMEs and customer size were also presented, in order to understand how this market development is occurring in comparison to SMEs.

3.3.4 Interview Guide – Supply Chain Specialist

The interview guide for the supply chain specialist had an overarching goal to gain a more holistic perspective over the future of supply chains. The type of data hereby collected also targets RQ1, focusing mostly on a future scenario, and relying in some level of speculation. Thus, it is considerably similar to the data collected from Blockchain specialists, but instead taking a view slightly broader to look at the role of other technologies, whilst maintaining the overarching focus in BCT.

The interview driving interview questionnaire used for the research was the same used for Blockchain specialists, found in Appendix 2. However, the application of the questionnaire during the interview was considerably different. The interview followed a more unstructured process, where many of the driving questions were developed during the interview according to the initial responses. Most questions were presented very broadly, following the principles established by Fitzpatrick (2013), while some were designed to gain deeper insights in specific aspects presented by the interviewee.

The overarching goal of this interview was to collect data on how future supply chains will look, and to evaluate the role of Blockchain technology from third perspective. As some bias could emerge from Blockchain specialists regarding the importance of BCT and its future role, this interviewed allows a better triangulation to validate the data collected in previous interviews and explore discrepancies. It also allows the research to explore the role of certain other technologies in reshaping supply chains, further contributing to the understanding of BCT role in it. The interview does not aim to answer RQ2 and serves only a minor role in exploring the role of BCT in today's SME supply chains.

3.4 Data Analysis

This research has been focused on collecting qualitative data through semi-structured interviews. The inductive nature of the paper led to changes in the scope and purpose of the study, driven by the data that was collected. Furthermore, although the interview process did follow a structure, it has also been iterated and adapted to different interviewee profiles, as previously described. This means that the data was collected and compiled in a rather unstructured manner, approaching the same topics but through different questions and different perspectives. Such small – yet highly descriptive – dataset requires a very flexible approach to data analysis.

For such purpose, Clarke and Braun (2017) distinguishes their approach to Thematic Analysis for its high flexibility and wide range of applications. Thematic analysis can be used to find patterns across different datasets, by providing a structured approach to coding the data, and use these codes as building blocks to identify themes. In turn, these themes can help to better structure the organization and reporting the data, as well as to improve the analytic observations of the researcher (Clarke & Braun, 2017). Thus, a thematic analysis can be easily deployed in this paper, providing a flexible and systematic approach to data analysis.

Furthermore, the paper uses Braun and Clarke's (2006) six phases of thematic analysis. The dataset was firstly transcribed – and if necessary translated. After a review and familiarization with the data, initial codes were drafted. These codes were then reviewed and divided into possible themes. The themes are then reviewed comparing to each other, and to the different codes found in the dataset. They are then refined and better explored, creating a more descriptive review of the different themes and their role in the report. Finally, the analysis is concluded by reviewing the themes collected and examining their role compared to the research question and to the literature. (Braun & Clarke, 2006)

While the aforementioned process was conducted through the analysis process of the data, as with any paper the presentation of this data remains limited. Thus, the Results section of the thesis is presented according to the different themes identified in the analysis process, while the Analysis section goes deeper into the meaning of this data in relation to the literature and to the learnings from the data. The transcriptions are not presented in this report, but are available upon request.

3.5 Credibility

As with any other study, the credibility of this paper has also to be addressed, both in terms of reliability and validity. Through the whole research process established on this thesis, the reliability and validity of the study were always taken into consideration.

3.5.1 Reliability

The aspect of reliability has been deeply considered in this study, as to evaluate how the methodology presented correctly translates into the results gathered. While the process of collecting data has been highly iterative, the interview guides and questionnaires were presented in this paper as to carefully document how the research was conducted. Yin and Nilsson (2007) suggest that such documentation increases the reliability of a study.

However, certain limitations do apply due to the limited data sample size. A larger number of case studies has also been considered during this thesis as means of increasing both the reliability and validity. Particularly in the area of Blockchain Specialists, there is a heavy amount of speculation from the interviewees as to how the industry will look in the future, wherefore a larger number of case studies could contribute to increase the reliability. However, resource and time constraints apply, where there was also a considerable low interest by these companies to contribute to this research. Thus, only three case studies were conducted, which might present some limitations to the reliability of this study.

3.5.2 Validity

This study tried to improve its validity through several different ways. Firstly, all the case companies were investigated thoroughly, assuring that they were fit for the profiles established in this section. The interviewees also presented their position in the companies, which in turn provides some security that their knowledge in the field and industry are valid. The difficulty in establishing case companies, as established before, could lead to some limitations in the validity of this study. While all companies invited to the study had a background of interest, only few companies with interest participated in this study. Thereby, this paper uses a convenience sampling, which contributed to finding interviewees, but also could lead to results not so widely generalizable. Finally, the study also attempted to increase its validity by using triangulation, as presented below.

3.5.2.1 Triangulation

As presented throughout this thesis, three different case studies were carried, allowing different perspectives to be gathered around the same issue. The topic at hand in all case studies remains Blockchain and how it currently is and will affect the fashion industry in the future. However, to provide data more accurate both in the industry's current situation, and in how the technology might impact it in the future, different data sources were chosen to each case study. This constitutes a type of data source triangulation, where actors with different background were selected to discuss the same issues, leading to a better overview of the problem and validation of the data (Triangulation, 2014). Furthermore, the interview guides were adapted to fit into the different actors' profiles.

4 Findings

4.1 Case Companies

This research collected data from three different companies operating around IT solutions and with some connection to the fashion industry. As presented in the methodology section, these companies served to collect data from three majorly different perspectives. Firstly, an industry perspective was necessary to investigate the role of Blockchain solutions from a customer perspective. It was thus necessary to gather insights from a company working in close relation to the target group – namely fashion SMEs – to understand the behavior of this group and its readiness to pursue Blockchain Implementation.

Secondly, the goal was also to observe how companies working with Blockchain around the fashion industry are pursuing the technology. The goal was then to gather insights on how the Blockchain market is developing, and to understand how practitioners expect that the technology will affect the future of supply chains. Thirdly, a supply chain management perspective was also necessary to provide investigate the future of supply chains from a holistic perspective, exploring the role of BCT and other technologies in reshaping supply chains.

The different roles and activities carried by each company also plays a big role into how the data was reviewed and analyzed. NaviPro is a company working closely with small and medium enterprises in the fashion industry. Their focus is on improving internal processes for their customers, whereby they help with customizing ERP and other IT solutions that serve to that goal. Their very specific knowledge on the fashion market helps them to further understand the customer needs. This allows the company to provide a good overview of their customers' interest and perspective over Blockchain Technology (BCT), as well as to traceability and other supply chain methods.

TrusTrace is a company actively working with implementation of BCT as means to pursue traceability and sustainability, as well as implementing other supply chain methods. The company also has a focus on the fashion industry, which allows them to map how the implementation of BCT is occurring, the overall customer interest, and their perspective of the future of fashion supply chains.

Shantalla is a company specialized in providing advisory services and research for both public and private clients. While the company has a broad area of study, some of the fields approached are: Supply Ecosystems Integrity and Transparency; Traceability; Industry Standards; Technology advisory such as IoT or BCT; Sustainability. The company holds deep knowledge in the evolving field of supply chain management, and works across industries with research and advisory services, among other things, around how supply chains will develop in the future, including the role of Blockchain.

These different perspectives allow this research to further investigate the current picture of the market, how BCT might disrupt it, and the broader picture as to how supply chains will evolve. This contributes to building a more holistic perspective over the role of Blockchain and other technologies in today's fashion industry, and into building the future of fashion supply chains. Table 1 presents the companies interviewed, their role for this study, the service they provide, and the total number of interviews carried.

Table 1 – Case Companies

Company	NaviPro	TrusTrace	Shantalla
	NaviPro®	TRUSTRACE	Shantalla From Ideas to Solutions to Results
Role	*Industry Specialist*	*Blockchain Specialist*	*Supply Chain Specialist*
Service/Product	Provider of custom ERP solutions for SME in the Fashion Industry.	Provider of BCT applied solutions targeting traceability and sustainability.	Provider of advisory services, including technology advisory in BCT and IoT
Interviews	1 interview	2 interviews	1 interview
Interviewee Position	- Sales Manager - Marketing Manager	- Business Operations - Business Development	- Managing Principal and C+ level advisor

4.2 Themes

The different interviews provided different perspectives into the main impacts of Blockchain Technology (BCT) on supply chains, and particularly into fashion supply chains. The data was reviewed through a thematic analysis, as presented in the methodology section. Several codes were identified across different interviews, and there appears to be little contradiction within the data collected. This allowed a review to identify four major themes surrounding the data collected, namely (1) Industry Readiness; (2) Challenges to Implement BCT; (3) Drivers for BCT; and (4) Future of Supply Chains. These themes and their corresponding codes are summarized in table 2.

Table 2 – Themes and codes

Themes	Codes
Industry Readiness	- Brand is the customer - SCI and agility problems today - BCT growing in the Fashion Industry - BCT must become a decentralized network - SME disinterest in BCT today
Challenges to BCT Implementation	- Low Supplier Interest - Inaccurate Data - Cultural Differences - Industry Resistance to Change - BCT deployment for SMEs
Drivers for BCT Implementation	- Technology is ready - Larger Enterprises are BCT Drivers - Sustainability is a BCT Driver - Lowering Entry Costs
Future of Supply Chains	- Automated Trust - Towards widespread Supply Chain Integration - BCT to improve SCM - Collaborative Decision-making - Interoperability Systems

The themes identified present cohesion across findings from different interviews. Furthermore, these themes also serve to narrate a certain chronological aspect of the Blockchain impact in fashion supply chains. The industry readiness present the current situation of the industry and current perception around BCT. The challenges and driver for BCT implementation serve to describe how disruption in this industry is currently occurring, and how innovators are operating. Finally, the future of supply chains present how practitioners view the potential impact of BCT once the industry passes through this disruption, as well as the role of some other technologies. They further explored in the next section.

4.2.1 Industry Readiness

Theme	Codes
Industry Readiness	- Brand is the customer - SCI and agility problems today - BCT growing in the Fashion Industry - BCT must become a decentralized network - SME disinterest in BCT today

The industry readiness englobes different aspects of the data collected which present how the industry is operating today, in relation to the implementation of Blockchain. Here, the data from both Blockchain Specialists and Industry Specialists was vastly applied.

Firstly, it becomes clear looking at the way the different service providers operate, that the main actor of interest in the fashion supply chains are the brands. TrusTrace interviewees argue that the brand carries most of the image of the supply chain, both benefiting and suffering from it. Thus, they are the ones more likely to seek out better image for their supply chains, such as with sustainability or traceability aspects. This leads to Blockchain services being directed at these brands, and therefore they are considered the main paying user. In the case of TrusTrace, brands are the only paying customers.

For many of these brands, it seems that supply chain issues are rather common. In fact, most companies do not have a vastly integrated supply chain, and lack both agility and flexibility in their supply chain operations. Such aspects can be observed, for example, in procurement

processes for these companies, where seeking out new partners and suppliers is a lengthy and complex process. The supply chain specialist from Shantalla argues further that supply chains today are too linear, lacking integration and visibility, as data is not well shared across actors without a direct connection. This increments to the lack of efficiency in today's supply chains.

Despite such lack of supply chain efficiency, the industry specialist from NaviPro indicates there is very little interest from SMEs to pursue SCI or traceability. TrusTrace interviewees also indicate the industry still lagging behind in terms of Blockchain implementation. They argue, however, that this scenarios is slowly changing and BCT is growing in the fashion industry.

One of the major complications explored by both interviewees from TrusTrace, is that Blockchain as a technology is not going to drive all the change. Customers seeking to use BCT without pursuing broader partnerships, are only implementing a more expensive database with very few benefits for the company's supply chain. Instead, for Blockchain to successfully help supply chain efficiency and integration, it is necessary to involve multiple actors and suppliers form the supply chain, to create a vast decentralized network. Only when this decentralized network has been established can the benefits be perceived by the supply chain.

Finally, the perception for SMEs from the fashion industry proved to be rather limited. The interview from NaviPro indicated that there is little industry knowledge about Blockchain, as the IT providers themselves were not very familiar with the technology. They indicated no customer explicit interest in BCT, which indicates that such technology is far from disrupting the current industry. Nonetheless, the interview from Shantalla indicates that traceability as a service is growing not only towards LE and MNE, but also towards SMEs, indicating that there is some growing interest in their solutions, even if it remains limited.

4.2.2 Challenges BCT Implementation

Theme	Codes
Challenges to BCT Implementation	- Low supplier interest - Inaccurate data - Cultural differences - Industry's resistance to change - BCT deployment for SMEs

While generally, the industry indicates that there is very little knowledge amidst SMEs in the fashion industry about Blockchain Technology, their interest has not been nonexistent. TrusTrace interviewees argue that their initial customers were SMEs, and that many small and medium brands presented interest into traceability. However, the issue remains, for BCT to truly provide some benefits for the brands, it is necessary to involve multiple actors and ideally pursue an end-to-end integration in this decentralized network. Such goal is not yet viable for most SMEs, which instead must seek integration to their suppliers in a tier-by-tier basis.

In this scenario, one main issue emerges for most companies as Interviewee A argues "*I would say the current challenge in the industry is data collection. It's not the technology, it is collecting this data*.". There is a lack of interest from suppliers to collaborate and share their data, as they often do not see any benefits from it. As previously argued, most of the benefits from BCT goes to the brand that carries the "image" of the supply chain . Thus, suppliers may be less likely to observe direct benefits from engaging in these collaborations, and afraid of repercussions from sharing their data.

Supply chain specialist from Shantalla argues further that even for larger companies, there is a big issue gathering accurate data for a Blockchain. He suggests that Blockchain's key feature – immutability – also acts as a weakness, as the data input in the system cannot be changed. He argued that *"supply chains have inaccurate data in them. Companies over-ship, under-ship, they make mistakes. So immutability can also be seen in a negative perspective."*. Thus Blockchain would have to be built on a foundation of clean data, rather than simply disrupting the current business processes.

Cultural and organizational paradigms also apply. Firstly, supply chains grew global and will often have companies from multiple cultures. Certain drivers for engaging in a Blockchain network may not be as relevant for companies in developing countries, as they are for companies in developed countries. Secondly, organizational culture must be considered, as resistance to change can emerge from a company's culture or from its leaders.

Furthermore, as building a BCT network requires a vast amount of engagement from multiple actors, the more resistance appear in a supply chain, the less likely BCT will drive a meaningful change. Hesitancy to sharing data could also appear from any actor, or emerge from regulations such as observed with the recent GDPR implementation. Thus, in order to pursue a broader BCT implementation and create these decentralized networks, it is necessary to build more momentum and create a broader demand for Blockchain services.

4.2.3 Drivers to BCT Implementation

Theme	Codes
Drivers for BCT Implementation	- Technology is ready - Larger Enterprises are BCT Drivers - Sustainability is a BCT Driver - Lowering Entry Costs

One of the key aspects to look at why Blockchain has such great potential, is exactly because of the technology. As presented by interviewee A from TrusTrace, most of the existing challenges are on changing the industry mentality, and not on developing BCT. The technology itself is mostly ready, its vast capabilities already exist, and what is left is changing the mentality of the different actors to get them to engage into a Blockchain network. The interview from Shantalla supports this argument, presenting that we have today the expertise and knowledge to implement BCT. There are currently two main drivers, beside the expertise in the technology, that appear to be pushing BCT implementation in the fashion industry.

Firstly, it seems that company size and influence over their supply chain has a great impact in pursuing Blockchain implementation and getting actors to collaborate. As opposed to SMEs, larger actors have more facility with convincing their suppliers to share data and to integrate multiple actors into the blockchain network. This means that the larger brands that are interested in pursuing Blockchain are more likely to see benefits from it, and to increase their interest in the technology and its applications.

Both interviewees form TrusTrace argue that it will be the larger actors who will push for an industry change and bring this disruption to the market. While small actors should be able to join later and make broad usage of Blockchain, it is unlikely that they would either have the interest or power to drive any systemic change as larger actors do. Interviewee B further argues that, for them as a company, larger customers also provide more revenue for the company. Thus, while they target companies of all sizes, they do have a preference for larger companies that can make better use of their services, as well as provide a larger revenue stream.

However, within the fashion industry, Blockchain Technology does not appear to be sold by service providers as means of improving supply chain agility or supply chain integration. There is a clear focus on Sustainability, and using traceability as means to pursue it. Blockchain is indeed a clear enabler of sustainability, as traceability has been mostly used to help companies track their supply chain and truly make them more sustainable. Furthermore, a decentralized network would enable companies to provide solid data to back their sustainability claims.

With growing consumer awareness and a huge trend in sustainability in the fashion industry, this factor becomes a huge driver for BCT. As the technology has the potential to bring transparency to supply chains and improve social and environmental efforts, it is a great opportunity for brands seeking to improve their image and to reach their sustainability goals. Thus sustainability appears to be one of the key drivers and main sale points from BCT in the fashion industry.

Finally, supply chain specialist from Shantalla indicates that the emerging technologies, including Blockchain, are becoming more democratized and easily available for organizations. He suggests that the entry costs for technology are getting smaller, and thus its implementation by SMEs will increase when compared to previous technological implementations, further exemplifying: *“I think the days where organizations paid a million dollars or five million dollars for technology, those days are gone”*.

4.2.4 Future of Supply Chains

Themes	Codes
Future of Supply Chains	- Automated trust - BCT to improve SCM - Towards widespread Supply Chain Integration - Collaborative decision-making - Interoperability Systems

Blockchain is a technology is making its way across different industries and fields. While the impact of the technology could be various, one of the foundations behind it is that the technology promises to create a network without possibility of forgery or altering the data that has been input. Ultimately, this removes the necessity of trust to be gained between two parties in the network, as it operates with a certain type of 'automated trust'. TrusTrace Interviewee B argued:

"*I think that in the long term, Blockchain will be able to replace the process, or the foundation, of 'Trust' that we have today*." (…) "*What we see that [Blockchain] could do is to disrupt this, and handle trust in an automated manner*".

While this environment with an automated trust could have numerous benefits across industries, in the context of supply chain management it should lead to more efficient and agile supply chains, as argued by TrusTrace Interviewee B:

"*Blockchain kind of provides a promise to stablish this [automated] trust, or single source of truth, so that you can take this quick and agile decisions in changing your supply chain, or using newer materials, or being able to offer personalized kind of products with a pull strategy, rather than a push*".

Thus the creation of such decentralized networks, enabled by BCT, would allow far more companies to seek methods for improving their supply chains. The range of application is quite extensive, where pull strategy, supply chain flexibility, agility, transparency and other concepts would be very viable for most companies within a Blockchain network.

Ultimately, both practitioners from TrusTrace argue that a vast supply chain integration should be the natural progression once Blockchain starts to dominate the market. The creation of such a decentralized network with automated trust should lead to a broader integration of processes and automation of such processes. Data could be shared instantly across the value chain, and changes in suppliers or partnerships could progress very easily.

When considering decision-making that might affect the entire supply chain, such integration may remain quite limited. While today's supply chain integration usually go around centralized data sources and management, blockchain would provide an entirely decentralized integration. Tools to enable a collaborative decision-making are viable from a technical sense, but it is still inviable to determine how they would be managed in a real network.

However, larger issues to drive such integration do emerge and are further explored by Shantalla's interviewee. While many of the integration aspects around information sharing and process coordination could be facilitated by Blockchain, the technology does not present a state-of-the-art solution. Instead, these are interoperability issues that require improved process for data exchange. While Blockchain solutions could solve that by creating decentralized networks, the data exchange remains limited to these networks and thus connections beyond the networks would remain an issue. Furthermore, as these decentralized networks are ran by specific companies, the solutions remain proprietary, which bring further risks to the actors involved and their respective data. Instead, what could promote a much broader supply chain integration is the creation of an interoperability solution that is not limited to the Blockchain networks.

The supply chain specialist at Shantalla further explores that there is only one interoperability solution gaining ground, OriginTrail. Their solution allows organizations to exchange data through a standards-based process, while also being neutral and open source. Thus, it could connect disparate ERP systems across different organizations, and promote a vast data sharing across different systems and databases. This works in coherence to the decentralized networks explained by TrusTrace practitioners, but only further enhancing it and permitting quick information sharing and process coordination across different networks and actors.

Finally, Shantalla's interviewee argues that supply chains are shifting from a linear perspective towards a system's perspective, where Blockchain might not be the fundamental technology in a far future, but it will certainly be fundamental to promote this shift.

5 Analysis

5.1 Blockchain and Supply Chain Management

Blockchain is a technology making its way across several different industries. The role of the technology has often been linked to that of a disruptive innovation, which tend to break market paradigms and establish new ones. In the field of supply chain management, Blockchain has the potential to drastically change how supply chains currently operate. Within the context of fashion supply chains, literature surrounding Blockchain Technology is rather limited. Most studies surround the field of sustainability, as to how Blockchain could enable extensive traceability, waste reduction and even circular supply chains. The data gathered from practitioners seem to support such conclusion, as sustainability appears as a key driver for BCT implementation today.

Furthermore, the literature is even more limited when observing the impacts of BCT in small and medium enterprises. That is also noticed in the data collected, whereby we observe that larger enterprises are more likely to pursue Blockchain today. There are several likely reasons for that. The data suggests that SMEs are less aware of BCT and its potential applications and that they lack most resources necessary to pursue the creation of a Blockchain decentralized network. Larger enterprises not only are more aware, but they also have more influence and power over their supply chains, helping them to better convince other supply chain actors to collaborate. As today's implementation of Blockchain is largely hindered by hesitancy to commit and sharing data, as well as predominance of inaccurate data. In this sense, larger enterprises are more likely to overcome such barriers.

It is also a matter of business opportunities for emerging Blockchain solutions. As the market is still in a very early stage, there is a limited number of companies providing Blockchain services. As such, these providers are likely to seek out the best revenue streams available, which naturally tend to come from larger companies. Thus, most market indicators show that larger enterprises are more likely to drive the disruption of the current market by BCT. This is a major explanation to why the literature surrounding Blockchain impact in SMEs is so limited, as these companies are unlikely to be largely affected by Blockchain in an early stage. However, as Blockchain networks advances as the new normal throughout the market, understanding its impacts in SMEs will also be majorly important to foresee how changes might occur in the macroeconomic environment.

5.1.1 SME Supply Chains and BCT

While today's market make for a very difficult implementation of BCT within SME supply chains, practitioners seem to agree that this is likely to change in the future. The issue remaining today is that BCT is not common, and its implementation requires a major disruption of supply chain structures. But once implemented, it is likely that SMEs will be capable of making use of the technology just as well as larger enterprises, and that entry barriers will be massively reduced. Today it appears that most implementation of BCT is driven by sustainability goals, which are largely focused at improving the supply chain image. As the brands usually carry the image of the supply chain, they are the actors most interested in pursuing the technology and its applications.

However, the benefits form a Blockchain network are far more extensive, and speak of a change in the nature of supply chain management. It could vastly improve the efficiency of supply chains and benefit operations for every actor involved. For example, suppliers could receive better forecasts of orders, and retailers adhere to a pull strategy.

While certain players are likely to benefit more than others, but it becomes clear that Blockchain networks should, in the future, bring benefits for multiple actors. As such benefits become more perceivable, it is more likely that companies from all sizes, including SMEs, will seek out BCT as means of improving their supply chain operations. This could even lead to shifts in monetization of Blockchain solutions, which today target mostly single customer in the supply chain. As most actors stand to benefit from BCT, it becomes more reasonable to distribute the costs across the supply chain, rather than charging a single brand. This in turn could lead to fewer entry barriers for SMEs, and enable them to pursue a supply chain integration.

Today, limitations still apply to both SMEs and to the entire concept of Blockchain. Smaller actors are also less mindful to supply chain efficiency or supply chain integration, and focus instead on improving internal processes. For BCT to actually change the business structures of SMEs, it would need not only to become more accessible, but also to showcase how it could impact the business processes of these companies.

5.2 Supply Chain Integration and BCT

Theory around supply chain integration (SCI) has changed a lot in the past decades. While in its earlier stage, it was mostly focused on vertical or horizontal integration of multinationals, IT systems transformed it into a broader concept that could be applied for companies with more limited reach. The dimensions of supply chain integration explored in this thesis follow a content-based approach: (1) Strategic Alliance; (2) Information Sharing; and (3) Process coordination. It is noticeable that larger enterprises remain more capable to pursue SCI in all these three dimensions despite all.

Nonetheless, supply chain integration has been proposed for SMEs and there are studies supporting its viability and benefits. However, such integration remains limited and many SMEs in the fashion industry don't take it into deep consideration. In fact, supply chain operations are usually not a very deep concern of companies from this size. Yet, we observe how multinationals and large enterprises are capable of driving down costs and improving their businesses through integration of their supply chain. So while it remains not a full business goal for most SMEs in the fashion industry, the benefits from its implementation cannot be denied, as they have been addressed in the literature.

Despite this lack of interest in supply chain integration by many companies, practitioners agree that Blockchain is pushing most supply chains towards it. The creation of such decentralized networks, enabled by BCT, would bring major changes to the companies involved in those networks. This could facilitate all defining aspects of SCI, a deeper level of automation could vastly improve the process coordination, while data would also become available instantly across the entire network, creating an highly efficient process of information sharing. Finally, although still limited today, the aspect of strategy alliance could be better developed with a collaborative decision-making involved in these platforms.

This in turn could allow companies to make quicker decisions and operate at a higher efficiency, as well as higher flexibility, drawing benefits similar to both vertical and horizontal integration. While today's drive towards BCT remains driven by sustainability efforts and traceability, with time, companies should become more familiar with how BCT enables a deeper supply chain integration.

5.2.1 The Value of Vertical Integration

While Supply Chain Integration englobes a wider definition of integration, considering both horizontal and vertical layers of the supply chain, Vertical Integration is a term with more solid roots in the literature. It refers to a deeper integration of a supply chain, through ownership or control of an entire value chain. That is, a centralized management controls a deep level of integration in business processes and operations, which allows the implementation of methods and strategies to improve the supply chain efficiency. It allows the synchronization of the supply chain, strategic independence, reduction of waste, implementation of lean tools and etc.

Such activities have traditionally helped multinationals to gain competitive advantage against smaller actors, by reducing costs, improving strategic stance and overall better control over the supply chain. As companies need a centralized management to implement these tools over their supply chain, such activities have been limited to MNEs and companies with high power of influence over their supply chain. That is, SMEs have not been capable of pursuing these tools and techniques, as they were a privilege of vertically integrated companies.

5.2.2 A Decentralized Vertical Integration

With the advances of Blockchain technology and its potential impacts in supply chain integration, the aforementioned limitations might no longer be applicable. By nature, the decentralized networks that are enabled by BCT, are capable of integrating business processes and operations across multiple actors, enabling a deeper level of automation and efficiency in the supply chain. It will also allow companies that do not have vast power over their supply chains to use of such tools and techniques to improve their internal and external operations.

Such integration could allow companies to create more agile supply chains, take quicker decision, or even implement a pull strategy, which is today limited to companies with large power of influence. The benefits are quite numerous and emerge from a decentralized environment, meaning that it is not technically necessary for one actor to manage the entire value chain. Certain disadvantages could also emerge from this decentralized nature. Differently from a vertical integration, the lack of a central management limits the viability for major strategic decisions that can impact the entire supply chain. This could yield fewer benefits than a true Vertical Integration, as the company at hand would not gain a strong positioning against its competitors or major control over the entire supply chain.

Yet, this might also be perceived as a benefit for the overall supply chain. It means that Blockchain could enable a deep supply chain integration and automation, yielding most of the benefits common to a Vertical Integration, but not risking the appearance of a monopoly, and even 'democratizing' the supply chain. Such decentralized vertical integration would enable a greater number of companies to pursue the same benefits of VI, but without risking destabilizing the market.

5.2.3 Interoperability Solutions

Despite the great advances that Blockchain technology brings, in particular through the creation of these decentralized networks, major overlying issues remain. Information sharing and process coordination across organizations in different networks – that is using different Blockchain providers – would remain very difficult. This in turn means that most companies in a single value chain would need to be a part of the same network to maximize the efficiency and automation of the supply chain, which can be very hard to achieve in a practical sense. Furthermore, as these decentralized networks are generally governed by specific companies or organizations, it means a risk of monopolies or oligopolies over the data could appear. Such issues could hinder adoption, as several actors are already hesitant in sharing their data.

This indicates to some extent that Blockchain is not quite the ideal solution to promote such a deep level of supply chain integration. Instead, the majorly necessary factor to promote a broader process coordination and information sharing is the emergence of interoperability systems. Such systems would promote a standardized method for data exchange, and allow organizations to easily connect their different IT systems and integrate their supply chains. Some solutions in this field are already emerging, indicating that this could be a reality soon.

While the emergence of interoperability solutions may indicate that Blockchain would not be the state-of-the-art solution for supply chains, it does not indicate that BCT should not be used to drive supply chain integration. In fact, both solutions are very aligned today and could be implemented together to improve supply chain operations. Interoperability solutions emerge, instead, as an extra step that can solve many of the shortcomings of Blockchain, and perhaps drive SCI even further once new technologies come to replace BCT. It begs the question if such interoperability solutions could promote a broader change than BCT, and if they might even become a General-Purpose Technology.

5.3 Synthetic Vertical Integration

The prospect of a greater supply chain integration, driven by Blockchain and emerging interoperability systems, has numerous similarities to a vertical integration. It appears to enable many SCM tools to be implemented and to drive forward supply chain efficiency. It also holds certain benefits common to horizontal integration, such as an increased supply chain flexibility. However, the proposal of the Blockchain networks is mostly directed towards a company's value chain, which usually will refer to a greater collaboration in a vertical sense. This does not mean to say that horizontal collaborations will not occur, in fact they appear likely to increase with the growth of interoperability systems. But it does indicate that such Blockchain-drive SCI has a stronger vertical nature, as well as it relates mostly to the benefits observed in VI.

As Vertical Integration is an old concept, it is still locked together with the idea of control or ownership of a supply chain. The modern technology that enhanced supply chain efficiency and overall integration has been linked to the original concept as a key enabler of vertical integration. But in fact, as observed in the literature, the term is still locked in the meaning of ownership and control. It has, however, a fundamental role in presenting this type of integrations, where companies exert such control over their supply chains. Thus it is a term unfit to describe the potential decentralized integration that Blockchain could enable.

Instead, Blockchain and interoperability systems propose a type of integration from a decentralized nature, where most processes and operations are synchronized, but no central management controls the entire supply chain. Ergo, it is arguably a copy or artificial type of vertical integration. The term 'Synthetic' is added in this context to provide a better description to the concept hereby proposed, a *'Synthetic Vertical Integration'*.

There are several reasons for addressing this type of integration as a unique concept. The role of BCT in reshaping supply chains is creating unique networks which will enable integration of actors in an unforeseen way, whereby interoperability solutions will only contribute to this. As addressed, such integration cannot be accurately described by Vertical Integration due to the decentralized nature. While Supply Chain Integration does englobe this type of integration, it does not indicate the depth of integration, and therefore appears as a more generic term. The use of Synthetic Vertical Integration (SVI) as a unique concept, can help to describe the vast depth of integration that Blockchain will enable, indicating how it will entail very similar benefits to a vertical integration.

The role of SVI in reshaping the economy could be quite extensive and march beyond the current business goals of practitioners. While larger enterprises continue to lead BCT implementation today, practitioners support that SMEs should pursue it as well in the future. This indicates that smaller companies could, by all means, pursue SVI and implement supply chain methods and techniques that are, today, a privilege of larger actors. In this sense, SVI holds the potential of removing a major competitive advantage that multinationals have held over SMEs for several decades.

The picture grows more complex as we see how other digital tools are already limiting the competitive advantage of large incumbents in the fashion industry. Small and medium brands are growingly empowered by tools such as Shopify, Alibaba, as well as large actors such as Amazon or Zalando, that enable them to reach out to more customers. In such environment, SVI might appear as another indicator that smaller actors are slowly re-gaining a competitive edge against larger incumbents.

6 Conclusion

6.1 Blockchain Impacts in Supply Chains

Blockchain is a technology that has the potential to reshape how businesses operates in many different industries, and overall disrupt the manner that markets operate today. In the context of Supply Chain Management, the technology could allow the creation of vast decentralized networks, so that companies could have a greater integration of their supply chain, driven by a efficient information sharing, process coordination, and improved strategic alliances. This could lead to vast increase in supply chain efficiency, flexibility and agility.

However, to reach such level of integration, it is necessary to engage multiple partners in the Blockchain network, to share data and create a deeper collaboration. In today's environment, many actors are hesitant towards sharing data and unfamiliar with the technology. As these blockchain networks are proprietary, the issues around data management might only grow, and supply chain integration would be limited to the actors inside such decentralized networks. The emergence of interoperability solutions to facilitate data exchange across actors within or outside these Blockchain networks, could vastly improve the integration of value chains and solve many of the shortcomings of Blockchain.

Today, the pursuit of supply chain integration remains considerably limited for SMEs, due to their lack of resources, technological awareness, and overall interest in SCI. Thus, BCT implementation today is mainly pursued by larger companies. These companies are more capable of influencing other actors in their value chain, and pushing them to share data and enter these networks.

Even so, most companies engaging in BCT still have a limited reach. As this disruption requires a change in mindsets and in the structure of doing business, it is a process that will still take time to happen. While today it appears to be mostly driven by larger companies in pursuit of sustainability efforts, once both BCT and interoperability systems becomes a norm, it could have vast implications for SMEs as well.

6.2 Synthetic Vertical Integration

The possibility offered by Blockchain networks and interoperability systems to share data instantly across the value chain, as well as synchronize and automate business processes across actors, presents an entire new form of supply chain integration. Yet, the benefits perceived by those engaging in these integration are not very different from those of a Vertical Integration, namely implanting tools and methods for increase efficiency, visibility and agility. The major difference is the lack of a centralized management, which limits some of the benefits but also seem to reduce the risks and cons of vertical integration.

Thus, this paper coins this concept as a *'Synthetic Vertical Integration'*, as it is a form of integration yielding similar benefits as a vertical integration, but in a decentralized manner. The impacts of this concept could be many. For fashion SMEs, it is notable that SVI could allow them to regain a competitive edge against companies that are today vertically integrated (namely multinational and LE). Thus, in the context of digital transformation, SVI could in the future help to shift the balance in markets, giving more power to SMEs and reducing the value of a Vertical Integration.

6.3 Implications and Limitations

6.3.1 Practical Implications

This study has some valuable implications for practitioners. Firstly, it brings forth notable knowledge around Blockchain technology, as well as briefly discusses the emerging interoperability solutions. These solutions could vastly reshape the outlook of supply chains, whereby practitioners could benefit from understanding some its impacts.

Secondly, by proposing and exploring the concept of a synthetical vertical integration, this study also postulates a potential market opportunity that could be further studied by practitioners. The importance of automation and data exchange in supply chains is notable and could soon become a reality for small and medium enterprises. Thus, with the advances of these new technologies, it could be possible for a company to sell the service of supply chain integration for SMEs, helping smaller actors to better integrate their supply chains.

6.3.2 Theoretical Implications and Further Research

While the data presented in this study is somewhat limited, there are notable contributions to the literature. Firstly, it reinstates that Blockchain technology and emerging systems could bring a much broader supply chain integration to the fashion industry. Nonetheless, it also indicates that today's fashion supply chains remain largely unaffected by the system and there are several challenges to drive its implementation.

Secondly, this study explores the how supply chain integration could become a reality for small and medium enterprises in the future. As supply chain integration, in the form of vertical integration, has long given a competitive advantage to larger companies, the advance of such 'synthetic vertical integration' could reduce one of the competitive advantages of MNEs and LEs over SMEs. While this would depend on a broad application of BCT and interoperability systems, it could be a sign of democratization of the market, contributing to making the global economy freer and pushing towards a perfect competition. This paper argues that researches should pay a greater attention to SMEs and explore their growing role in the future economy.

Finally, while Blockchain has been vastly addressed as a great solution for several different markets – and this thesis supports such arguments – it may also not be the state-of-the-art solution that it is often made out to be. Instead, this research identifies the emerging interoperability solutions (such as OriginTrail) as a technology with potentially more importance than Blockchain itself. The underlying potential application of such interoperability solutions are of such magnitude that it begs the question if it has potential to be a General-Purpose Technology. This paper argues that further research should be carried around interoperability solution to explore its role in changing today's economy and society.

6.3.3 Limitations

This paper suffers from several limitations. Firstly, resource and time constraints limited the data collection, wherefore the reliability of the paper is somewhat limited. Furthermore, the major concept hereby proposed, namely SVI, is entirely new, and constructed on the expectations that a set of technologies will disrupt the market. It is also heavily influenced by the opinion and future expectations of practitioners, as only minor indications appear in today's application of BCT. Thus, the major results of this paper are heavily speculative. This, however, remains within the goal of this research and bound to its inductive reasoning.

7 References

Bell, E., Bryman, A., & Harley, B. (2018). Business research methods. *Oxford university press.*

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.

Camargo, L. R., Pereira, S. C. F., & Scarpin, M. R. S. (2020). Fast and ultra-fast fashion supply chain management: an exploratory research. *International Journal of Retail & Distribution Management*.

Clarke, V., & Braun, V. (2017). Thematic analysis. *The Journal of Positive Psychology*, 12(3), 297-298.

David-West, O. (2020). Information and Communications Technology (ICT) and the Supply Chain. In Information Resources Management Association (Ed.). *Supply Chain and Logistics Management: Concepts, Methodologies, Tools, and Applications* (pp. 578 - 599). United States of America: IGI Global.

Fitzpatrick, R. (2013). The Mom Test: How to talk to customers & learn if your business is a good idea when everyone is lying to you. *Robfitz Ltd.*

Guo, S., Sun, X., & Lam, H. K. (2020). Applications of Blockchain Technology in Sustainable Fashion Supply Chains: Operational Transparency and Environmental Efforts. *IEEE Transactions on Engineering Management*.

Harrigan, K. (1985). Vertical Integration and Corporate Strategy. *The Academy of Management Journal*, 28(2), 397-425. Retrieved March 10, 2021, from http://www.jstor.org/stable/256208

Kane, E. (2017). Is Blockchain a General Purpose Technology?. Available at SSRN 2932585.

Koh, L., Orzes, G., & Jia, F. J. (2019). The fourth industrial revolution (Industry 4.0): technologies disruption on operations and supply chain management. *International Journal of Operations & Production Management*.

Li, Q., & Liu, A. (2019). Big data driven supply chain management. *Procedia CIRP*, 81, 1089-1094.

Mahoney, J. (1992). The Choice of Organizational Form: Vertical Financial Ownership Versus Other Methods of Vertical Integration. *Strategic Management Journal*, 13(8), 559-584. Retrieved March 10, 2021, from http://www.jstor.org/stable/2486651

Parikh, T. (2018). The ERP of the future: blockchain of things. *Int. J. Sci. Res. Sci. Eng. Technol.*, 4(1), 1341-1348.

Patro, C. S., & Raghunath, K. M. (2020). Information Technology Paraphernalia for Supply Chain Management Decisions. In Information Resources Management Association (Ed.). *Supply Chain and Logistics Management: Concepts, Methodologies, Tools, and Applications* (pp. 551 - 577). United States of America: IGI Global.

Sousa, M. J., Cruz, R., Dias, I., & Caracol, C. (2020). Information Management Systems in the Supply Chain. In Information Resources Management Association (Ed.). *Supply Chain and Logistics Management: Concepts, Methodologies, Tools, and Applications* (pp. 600 - 616). United States of America: IGI Global.

Triangulation, D. S. (2014, September). The use of triangulation in qualitative research. *In Oncol Nurs Forum* (Vol. 41, No. 5, pp. 545-7).

Vijayan, G., Kamarulzaman, N. H., Mukherjee, A., & Vaiappuri, S. K. (2020). Strategic Value Creation in a Supply Chain. In Information Resources Management Association (Ed.). *Supply Chain and Logistics Management: Concepts, Methodologies, Tools, and Applications* (pp. 1 - 19). United States of America: IGI Global.

Voronchenko, K. (2017). Do you need a Blockchain?. Supervised by Ivo Kubjas, 22.

Wang, B., Childerhouse, P., Yuanfei Kang, Baofeng Huo, & Mathrani, S. (2016). Enablers of supply chain integration. *Industrial Management Data Systems*, 116(4), 838-855.

Wang, B., Luo, W., Zhang, A., Tian, Z., & Li, Z. (2020). Blockchain-enabled circular supply chain management: A system architecture for fast fashion. *Computers in Industry*, 123, 103324.

Wang, M., Wang, B., & Abareshi, A. (2020). Blockchain Technology and Its Role in Enhancing Supply Chain Integration Capability and Reducing Carbon Emission: A Conceptual Framework. *Sustainability*, 12(24), 10550. MDPI AG.

Yin, R. K., & Nilsson, B. (2007). Fallstudier: design och genomförande. *Liber*.

8 Appendices

8.1 Appendix 1

1. Questions about the company
    a. What BCT solution does TrusTrace provide?
    b. Which industries do you target? Why?

2. Questions about BCT impact in the Fashion industry
    a. How will BCT change SCM in the Fashion Industry?
    b. Do you see BCT as an enabler of supply chain integration?
    c. Does TrusTrace plan to work with SCI in the future?

3. Questions about BCT impact in SMEs
    a. What customers are most interested in your solutions? (SME, LE, MNE)
    b. Does customer size matters to pursue implementation of BCT across supply chain?
    c. How do upstream actors benefit from TrusTrace? Who is the paying customer?
    d. What are the main challenges for SMEs to use your systems?

4. Questions about competition
    a. How widespread is BCT in the industry? Are there many companies developing these systems?
    b. Is there a focus on traceability, or also in SCI and SCM?

5. Technical question
    a. If BCT is used for traceability, how different would the system be to a SCI system?

8.2 Appendix 2

Open Question (discussion): What are the major impacts of Blockchain in Supply Chain Management?

1. In terms of Supply Chain Integration (increased efficiency and collaboration), what are the major impacts Blockchain could have?
    a. How do you think supply chains will look in the future (10 – 30 years)?
    b. What are Smart Contracts? How can they impact SCI?

2. How does Blockchain enable collaborative decision making?
    a. What are the challenges to implement it?

3. Which are the industries more prone to implement Blockchain?
    a. What is the outlook in the fashion industry?
    b. Does company size play a role?
    c. What is the outlook for SMEs?

4. Considering your vision for future supply chains (1a), what are the major challenges to reach that vision?

5. (Company Data) What innovations is TrusTrace bringing to this field?
    a. What are your target customers and industries?
    b. What are the main challenges for the company to grow?

8.3 Appendix 3

1. About the company
    a. What main solutions does NaviPro provides?
    b. What is your target group?
    c. How do you create value for your customers?

2. About the company and Supply Chains
    a. Do you work with supply chain integration? Such as coordination and information sharing from multiple actors.
        i. (Yes) Who is the paying customer?
        ii. (No) Why not? Do you plan to work with it in the future?
    b. Do you work with traceability?
        i. (Yes) Who is the paying customer?
        ii. (No) Why not? Do you plan to work with it in the future?

3. About Blockchain's impact in the Fashion Industry
    a. Do you work or plan to work with Blockchain?
    b. How do you expect Blockchain to affect the fashion industry?
    c. What are the biggest challenges to implement Blockchain?
    d. Does customer size matters for Blockchain implementation?