

**The Promise of Blockchain and its Impact on Relationships between Actors in the  
Supply Chain: A Theory-Based Research Framework.**

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## **Abstract**

This research evaluates the impact of blockchain technology for supply chain management and the relationships between different actors; the relevant findings are analysed through the lens of the Global Factory model. This paper extends this conceptual framework aiming to guide organizations in their implementation of blockchain and understand how relationships are being impacted.

The findings of this research are drawn from a thematic analysis of thirty-three interviews with participants from different backgrounds. This research finds that blockchain is impacting the relationships between different actors in a variety of different ways. This paper identifies four key areas that organizations need to understand when examining the adoption of blockchain: clarity of strategy; trust; cooperative relationships and coordination.

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## **Chapter 1: Introduction**

In the last few decades, supply chain management (SCM) has become an ever-difficult task as value chains become increasingly dispersed and disconnected. Moreover, we are living in a new era referred to as the 'Digital Age', characterized by a shift from the traditional economic model, to an economy based on information and data. This is redefining the rules of international business and how companies operate and interact. One technology that is playing a central role in this transformation is blockchain.

### **1.1 Background**

Global supply chains, particularly food supply chains, have become so complex and internationally distributed over the past 50 years due to globalisation, which consequently has increased the risks associated with coordinating and managing the end-to-end processes (The Times, 2018). Depending on the product, the supply chain can involve multiple stages, through multiple geographical locations, involving various payments and invoices, with numerous actors involved, culminating in a convoluted chain of procedures (Marr, 2018). It has become increasingly difficult to track, trace and monitor the flow of goods from point of origin through to point of consumption, for both customers and organizations, which subsequently impacts the levels of trust (Hewett and Deshmukh, 2019).

Therefore, as supply chains have diverged from local networks to complex global networks of organizations, the level of uncertainty has increased alongside a decrease in the span of control, which has created governance gaps (EY, 2018). This is more prevalent today than ever before, as consumers have become increasingly conscious of knowing the provenance of the products they buy and will change their purchasing decisions if there are any signs of malpractices by an organization. Consequently, brand reputation today is significantly dependent on the ability to provide the level of transparency desired by consumers, as well as ensuring that nothing goes wrong within the supply chain. This is evident in high profile cases in the last decade or so, in which problems have occurred and confidence in the security of the food supply chain has decreased, for example the Romaine lettuce scare which saw substantial decline in levels of sales even months after the outbreak (Halkias, 2018).

The World Economic Forum (WEF) highlights that whilst on the surface, the supply chain of the future will appear similar to that of today, “under the covers we can anticipate far-reaching changes that enable better communication, fewer disputes, higher system resiliency and substantial gains in operational efficiency”, due to blockchain technology (WEF, 2019).

The inherent characteristics of blockchain, which will be highlighted in section 2.1, have the potential to increase the traceability throughout the whole system, providing greater transparency of a product’s history, which gives a layer of assurance and trust which previously was not possible using existing systems.

This research will be framed through a conceptual framework known as the ‘Global Factory Model’, analysing how organizations can systematically change how they manage and coordinate their global supply chains through the implementation of blockchain, and how this can impact relationships between different actors. Blockchain within the supply chain has not yet been examined through this perspective, so this research fills an obvious research gap (Figure 1).

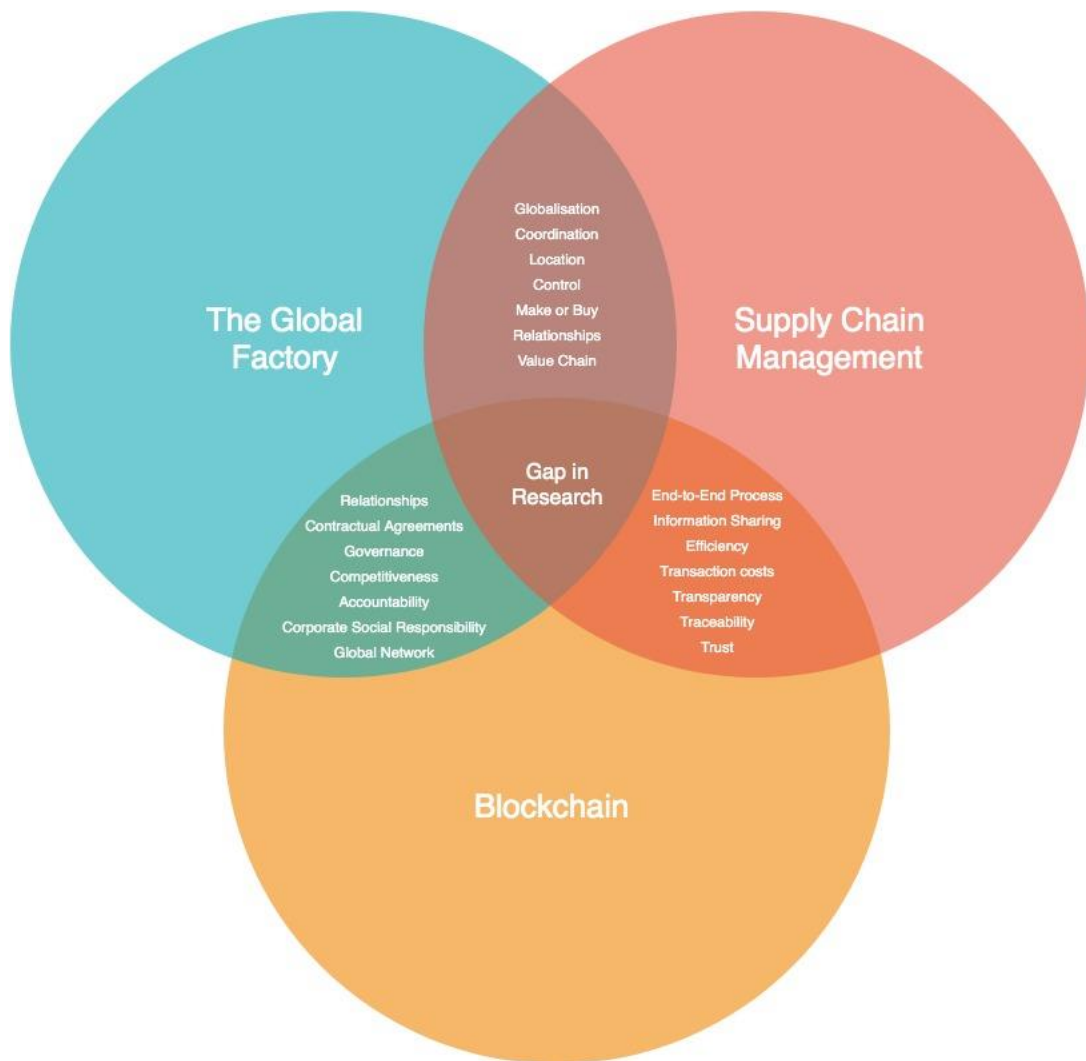


Figure 1 - Research Gap.

## **1.2 This Research**

There has been substantial research already into blockchain technology within SCM in general, but there has yet to be a rigorous treatment of how relationships between different actors are impacted, as well as applications of academic theories in this context. My primary research question tackles this general overview of relationships within the supply chain, which is supported by three sub-questions derived from The Global Factory Model<sup>1</sup>, as defined below:

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<sup>1</sup> See section 2.4.



1. How will blockchain technology impact the relationships between actors in the supply chain?
  - a) How does blockchain affect the decision of internalisation versus externalisation?
  - b) How does blockchain impact location choices?
  - c) How does blockchain influence the coordination and orchestration of a supply chain network?

*Overall Hypothesis: Blockchain will make it easier to manage distributed value chains.*

This paper therefore provides an analysis of blockchain within the supply chain that can be adapted and utilised in the industry to enhance relationships between actors and increase the ability for managers to coordinate and govern their network. It examines the impact of blockchain in relation to trust, transparency and traceability within a supply chain, using the food industry as an example. This forms the foundations for a deeper, theoretical analysis using the Global Factory (GF) model as a conceptual framework, to understand how blockchain could transform the dynamics of the GF through a combination of key characteristics, which will be discussed in the following sections. Through an in-depth qualitative study, using a vast array of sources and drawing on theoretical material, I determine how blockchain affects the GF model and can assist the ability for managers to respond to shifts in the international operating environment.

## **Chapter 2: Literature Review**

### **2.1 Blockchain Literature**

#### **2.1.1 What is Blockchain?**

Blockchain was developed by Satoshi Nakamoto (2008) to create a transaction system based on cryptographic proof as opposed to trust. It enables economic transactions between relevant parties, without the need for a trusted third party (Tapscott and Tapscott, 2016). Thus, blockchain is a peer-to-peer system with no central authority managing data flow (Laurence, 2017).

Many definitions exist to describe blockchain; I find two particular definitions effective and encapsulate fundamental benefits:

1. *A digital, decentralized and distributed ledger in which transactions are logged and added in chronological order with the goal of creating permanent and tamper-proof records* (Treiblmaier, 2018).
2. *A trusted, distributed ledger with shared business processes* (Palfreyman, 2018).

In a blockchain system, transactions are recorded on an electronically distributed ledger which creates a 'block' (Figure 1). Each block is connected to the blocks before and after it which creates a chain via a hashing function. Once connected within a chain, the blocks become immutable and so cannot be tampered with by a single actor (Wang et al., 2019). Instead, they are governed by a consensus mechanism, which is decentralized (Swan, 2015). The consensus mechanism is referred to as proof-of-work, which prevents double-spending in the network (Ravel, 2016). The blocks are verified by nodes – the computers/users participating in a blockchain network – with each node containing a complete record of all the transactions ever recorded in that blockchain (Wang et al, 2019). Thus, blockchain provides more security than traditional transaction processes due to the audit trail of activities that is created (Miles, 2017).

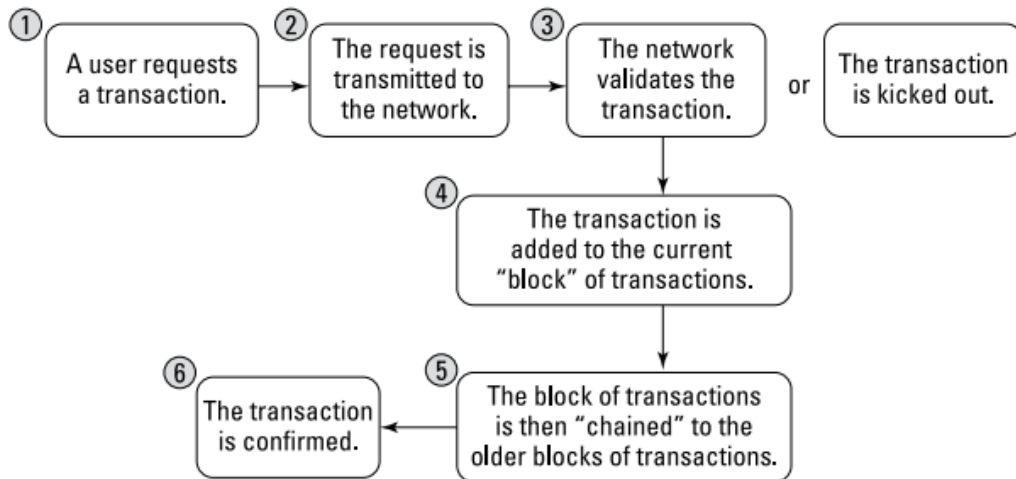


Figure 2 - How blockchains work (Laurence, 2017).

### 2.1.2 Key Characteristics

Four characteristics set blockchain apart from most existing information systems designs (Pattison, 2017; Saberi et al., 2019):

- *Distributed and synchronized across networks.* Organisations are encouraged to share data and have reduced reliance on third parties because blockchains are peer-to-peer networks.
- *Smart execution.* Blockchains can be programmed to automatically initiate actions when certain conditions are met via smart contracts. A smart contract is a computer protocol that executes contract terms.
- *Consensus.* All relevant parties have to agree that a transaction is valid before it can be executed. This helps prevent inaccurate or fraudulent transactions out of the database, which in turn creates trust.
- *Immutability.* Data inputted on the database is permanent, chronologically ordered and available to all parties on the network. It means that agreed transactions are recorded and cannot be altered. This provides provenance of assets, which creates an audit trail detailing the history of the asset throughout its lifetime.

### 2.1.3 Hype versus Reality?

Blockchain has become a powerful buzzword, which strikes excitement but also caution amongst individuals who are aware of it. This excitement and hype can be illustrated via a company called Long Island Iced Tea, who announced that it was changing its name to ‘Long Blockchain Company’, and subsequently its stock jumped by nearly 500% (Bernard, 2018).

On the one hand, blockchain is perceived as a technology which could change our lives (Tapscott and Tapscott, 2016; HBR, 2017; Carson et al., 2018). On the other hand, some believe it is merely a pipe dream, or are concerned about the hype (Iansiti and Lakhani, 2017; Roubini and Byrne, 2019; Ganne, 2018). There exists a lack of agreement around the value of blockchain, which is reflected in the literature (Busby, 2018).



Figure 3 - Hype Cycle for Blockchain Business (Gartner, 2018).

This can be partly attributed to the immature state of blockchain technology. It is an emerging technology with few fully implemented and integrated applications of blockchain available as cases to study (Cole et al., 2019). This in turn affects the research which can be conducted due to the limited evidence available to assess the actual impact of blockchain technology (see Figure 3).

One area which blockchain technology is being heavily explored and invested in is SCM. The literature, in general, agrees that blockchain will disrupt the status quo and SCM, but there are still many challenges which need to be overcome (Wang et al., 2019).

## **2.2 Blockchain Technology in SCM**

### *2.2.1 What are the current SCM pain points organisations face today?*

For many firms, supply chains today usually consist of many dispersed and often disconnected actors (Accenture, 2018). The impact of globalization has largely removed barriers to trade and transformed how supply chains are organised and managed by organisations. Consequently, the supply chain is siloed and involves multiple stakeholders and an increasing number of multi-party transactions, thus increasing the complexity of operations. This has created fundamental challenges due to the complexity and diversity of interests (Casey and Wong, 2017). A product which passes along the supply chain from point of origin to its final destination can pass through the hands of many organisations with each holding their own version of ‘truth’ (World Economic Forum, 2019). This results in a lack of end-to-end visibility due to the fragmented nature of supply chains. Thus, in the era of globalization, in which a multi-tiered supply chain exists, companies must recognise they can no longer compete alone but need to structure, coordinate and manage their relationships in a networked manner (Hinshelwood et al., 2019).

As a result, SCM faces a number of key pain points. For example, issues such as traceability, compliance, accountability, enforcement, speed, agility, provenance, coordination, transparency and trust (Nikolakis et al., 2018; Ganeriwalla et al., 2018; Deloitte, 2017). These issues raise the question of whether current supply chain information systems can provide the information required to solve, or at least lessen, the impact of such challenges on business operations (Sabeti et al., 2019).

### 2.2.2 The Promise of Blockchain

Imagine a world in which an asset can be tracked throughout its whole life cycle using one single point of truth, providing greater visibility and real-time changes (Palfreyman, 2018; Hackius and Petersen, 2017; Casey and Wong, 2017). Blockchain has the potential to “revolutionize the way different actors capture, communicate and access information on a secure, shared and transparent platform” through which purchasing decisions throughout the supply chain can be made smarter (Deloitte, 2017; Provenance, 2015).

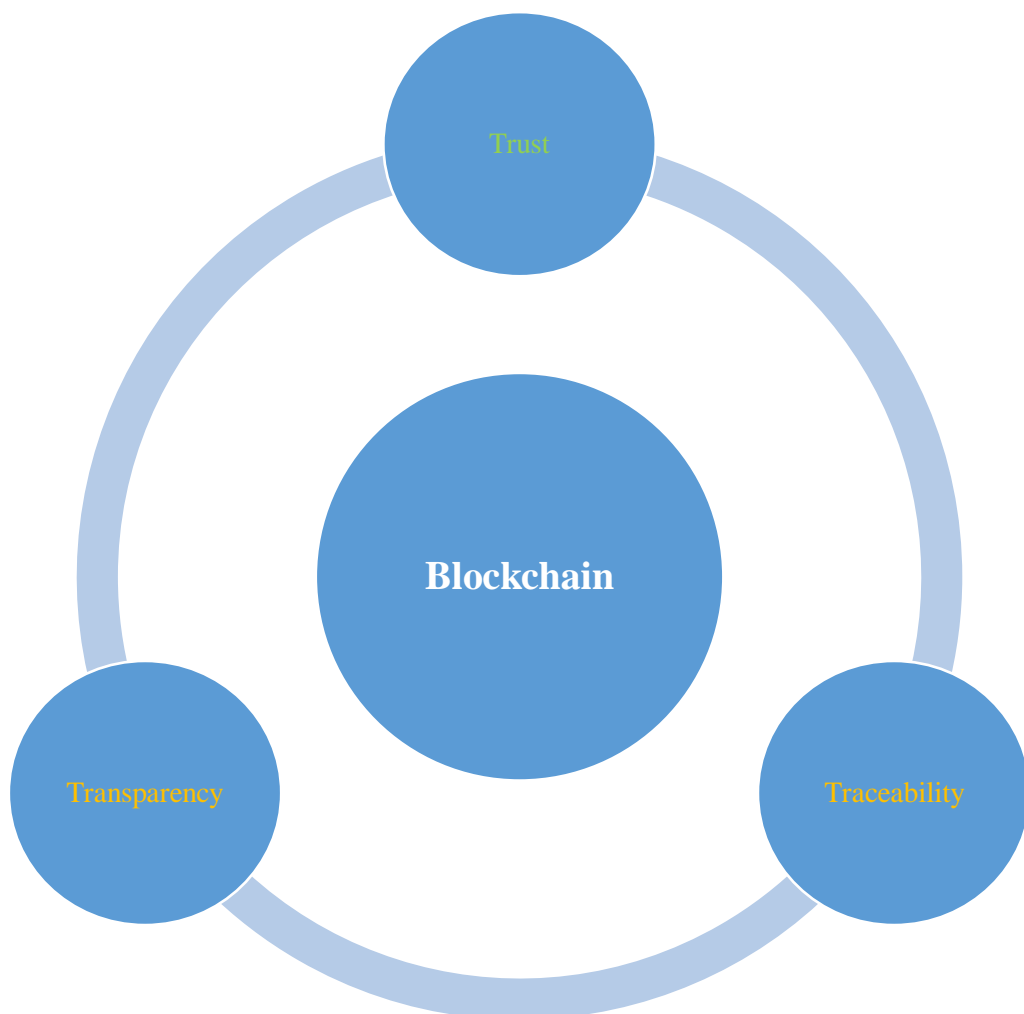
Supply chains today are being driven by “oceans of digital data” and increasing external pressure via social and legal influences - blockchain can assist companies to go from “islands of insight to an integrated global view” and provides a tool to respond to consumer and governmental pressure (Brody, 2017; Francisco and Swanson, 2018). It offers a world of connected data in which all players can see and share value throughout the supply chain (Wincanton, 2019; Schmahl et al., 2019). Although, blockchain is a team sport and so value must be created at each and every step of the value chain for actors to be incentivised to get on board (WEF, 2019; Walters, 2009). Importantly, a blockchain network is strongest when it included many diverse members that form a transacting ecosystem (Wolfson, 2019).

The ‘digital transformation’ of supply chains is resulting in increased “supply chain networks”, as opposed to traditional chains which, to a large extent, follow a linear economy model (Accenture, 2018). This will make it increasingly difficult to define organizational boundaries and lead to a new epoch built on characteristics such as openness, decentralization and global participation (Tapscott and Tapscott, 2016). Therefore, blockchain will create new-founded business value if the technology is applied to the right use-cases and a clear strategy exists for how its implementation will solve key SCM pain points, as well as providing value to every member on the network.

Although, to realise the full transformational benefits of blockchain, there is a need for technological combination. For example, the use of IoT and particularly digital twins, to provide the required security and transparency to serve as a shared platform. Digital twins are “virtual copies of physical objects or processes” which tie a physical object or process to its digital record in the blockchain (Deloitte, 2018).

### **2.3 Transparency, Traceability and Trust**

Blockchain-enabled transactions offer the potential to enhance the transparency and traceability of a product from its point of origin to the end consumer, which should ultimately impact the level of trust required for business transactions. The following section will break down each of these components to highlight the promise of blockchain, with a particular focus on the Food Industry. Figure 4 illustrates how these three characteristics work alongside each other in a cyclical nature, which I have referred to as the “Triple ‘T’ Framework”.



*Figure 4 - "Triple 'T' Framework".*

### 2.3.1 Transparency

One key aspect of blockchain is the level of transparency it will enable to participating companies. Consumers increasingly demand for more transparency, and an increasing number of organizations are reporting their sustainability performance, either for mandatory or voluntary reasons (Lyons, 2019; KPMG, 2013). However, “full chains of custody” which can provide a picture of a product’s journey remains limited and difficult to verify, and therefore trust (Provenance, 2015; New, 2010). There remains a schism between what a company reports openly and what actually occurs behind closed doors. In the digital age of today, coupled with rising business competition and increased market complexities created via globalisation, it is difficult for companies to monitor their expanding networks, whilst supply chain visibility has become increasingly important as companies outsource large parts of their supply chains. The cost of not knowing product provenance is enormous when things go wrong, as the repercussions impact brand reputation and consumer trust (New, 2013).

Blockchain provides the provenance needed through a secure, immutable and distributed log detailing the complete history of a product from farm to fork (Francisco and Swan, 2018). This increased visibility can mitigate the mistrust that often exists in the fragmented food supply chain today and provides reliability due to cryptographic proof (Schmahl et al., 2019). For example, in terms of procurement, companies often find issues with connecting the flow of information within their tiers, resulting in no option but to trust the word of their stakeholders (Deloitte, 2017; Brody, 2017). Blockchain is consequently perceived to drive accountability, enabling behavioural self-governance by actors in a network since every point of the food system will be placed in the spotlight (McKenzie, 2018). There will be no place for hiding in the shadows. Moreover, it will solve the outdated twenty-first century model of food traceability, in which actors are usually only able to see one-step-up and one-step-back (GS1, 2018).<sup>2</sup> Thus, blockchain will deliver radical transparency – the concept of “providing insights about a product that was previously unachievable through traditional means of data sharing” - and tackle the issue of information asymmetry (Deloitte, 2019; Tapscott and Tapscott, 2016). Therefore,

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<sup>2</sup> The extent of this depending on the type of blockchain designed and implemented. See Jaeger, 2018 in Bibliography.



blockchain could provide a “fully transparent, twenty-first century digitized food system” which can be perceived as the “Holy Grail” of traceability and transparency (Giles, 2018).

### 2.3.2 Traceability

Tracing products during their journey throughout the supply chain is a difficult task, since they often pass through multiple tiers of the network and therefore are exchanged between multiple hands. The whole process is disjointed and leads to disconnected data resulting in information asymmetry (KPMG, 2016). A key challenge for companies is the capability to exploit the “data tsunami” which exists in the modern supply chain and integrate insights into their existing operations (IBM, 2018). This has been the “Achilles heel” of food supply chains today (Giles, 2018). Traceability affects various business operations ranging from efficiency and product safety, to on-time delivery performance and regulatory compliance (Bateman, 2015). These are key challenges at the heart of the food industry, as well as governmental and consumer pressures for ethical and responsible sourcing. The rules in the global business arena need to change – actors need to become “co-operating gladiators” (Czintoka et al., 2014).

Therefore, traceability and provenance can bring many commercial benefits. For example, increased efficiency, reduction in costs, and due to more reliable data it can verify the authenticity, origin and ethical standards of products (Accenture, 2018; EPRS, 2017). Importantly, and given recent high-profile cases, supply chains can become more secure via the implementation of blockchain.<sup>3</sup> This in turn should have serious safety consequences and improve consumer confidence in their purchasing decisions (Wang et al., 2019). For example, through blockchain-enabled tracking, Walmart are able to track a package of sliced mangoes from its US stores back to their sourced farms in Mexico in 2.2 seconds, compared to around 7 days previously (Corkery and Popper, 2018). This increased efficiency enables companies to determine more quickly and precisely points of contamination if an outbreak occurs, and also potentially reduce food waste (Aitken, 2017). This could help to reduce food borne diseases – almost 1 in 10 people globally fall ill after consuming contaminated food and 420,000 die every year – due to the ability to respond quickly to recalls and other food safety issues (WHO, 2019).

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<sup>3</sup> For example, see: <https://www.bbc.co.uk/news/uk-21335872>

### 2.3.3 Trust

Today, a new smart global economy is being built and its foundation is an innovative digital platform of trust (HBR, 2017). Companies must take trust to the next level as consumers become ever-conscious about what is in the products they buy and where they come from (KPMG, 2016; TCGF, 2019). If a supply chain involves a small number of parties who already trust each other or are able to easily establish a single source of truth, traditional technologies should still be used (Schmahl et al., 2019). However, in today's supply chains most participants often don't know one another and lack visibility into each other's business operations, and therefore trust needs to be built in some other way (Ganeriwalla et al., 2018).

Trust in business is the expectation that participants involved in a transaction will behave according to key principles such as: honesty, accountability, competence and reliability (Tapscott and Tapscott, 2016; Botsman, 2017). This trust takes time to build and is increasingly difficult to establish as supply chains become more complex and digitalised. The problem with digital trust is trusting the information you are given and the parties which give you that information (Laurence, 2017). Blockchain enables "mere mortals to manufacture trust through clever code", as opposed to trusting intermediaries (Tapscott and Tapscott, 2016; Brody, 2017). Blockchain could therefore play a role as the "gatekeeper" in this new emerging economy acting as a "trust machine" (Deloitte, 2017; The Economist, 2015).

This has ignited debate within the literature around the concept of trust either increasing or reducing between participants on the network; some individuals call it a 'trustless' system (Cole et al., 2019; Field, 2017; Swan, 2015; Glaser, 2017). The truth is that it is not a trustless technology, it simply shifts the trust from one place to another (Lyons, 2019). Trust is transferred from intermediaries or individuals to the technology. This means that whilst participants may not trust each other, they can trust blockchain technology. Consequently, this could impact relational trust between different actors in the supply chain as trust is instead "programmed" through cryptographic data on the blockchain (Wang et al., 2019).

Blockchain could reconfigure the traditional ways of managing a supply chain network and potentially create new business models (Iansiti and Lakhani, 2017). For example,

applications built into the platform such as smart contracts which can govern and execute contractual agreements, could significantly change how transactions between participants are negotiated, contracted and enforced (Tapscott and Tapscott, 2016).

However, blockchain must still be used with a degree of caution since it is not free from vulnerabilities (EPRS, 2017). Data inserted onto the blockchain still requires human input which could be falsified or accidentally inserted incorrectly. Blockchain is unable to help with this process and so can't verify what can be perceived as the most important step of verification (Tucker and Catalini, 2018). Thus, it is dependent on trusting the agencies who are inputting information are not manipulating the data which could cause the dilemma of 'garbage in, garbage out'. Therefore, structures are being put in place to help ease this process, for example through the use of IoT sensors which help remove the possibility of human error and increase the reliability of information along the chain (Deloitte, 2017). Moreover, there is the need for "secure by design" to ensure that blockchain-based supply chain solutions are built with the appropriate levels of cyber security, which means new products and services must be designed and developed with "regulatory, cybersecurity and data-privacy compliance integrated from the outset" (Schou-Zibell and Phair, 2018).

Nevertheless, blockchain provides both trust and enables transactions which could not have occurred before. Whilst manipulated data can enter the system and is irremovable, it enables participants to identify corrupt data and its source more easily. This should lead to increased accountability and transform how we exchange value and whom we trust (Botsman, 2017). It will also transform how organizations are managed and organized, providing the capability to use resources either inside or outsource with the same ease (Tapscott and Tapscott, 2016b). This is the promise of blockchain.

#### **2.4 What role does the Global Factory play?**

The Global Factory (GF) is "a structure through which multinational enterprises (MNEs) integrate their global strategies, through a combination of innovation, distribution and production of both goods and services" (Buckley, 2009). Essentially, it's a commercial network, which involves complex flows of knowledge, intermediate products, and management skills; it involves globally dispersed activities, combining activities both in-

house and through externalized contractual relationships, which are coordinated by a lead firm (Buckley, Enderwick and Cross, 2018).

It makes key decisions on issues such as location and ownership/control:

- Where is an activity best located?
- What is the best means of control of each activity in the system?

(Buckley, 2011).

The dynamics of the GF are a response to the modern global economy and the impact of globalisation in how businesses coordinate their increasingly global networks. In response, managers have learned to “fine slice” core and non-core activities and locate each “stage” of activity in its optimal location and to control the whole supply chain, even without direct ownership (Buckley, 2009). This is based on the concept of not needing to own a facility to control it and follows the Coasean “externalise or internalise” decision – the decision to “buy” or “make” (Buckley, 2009; Coase, 1937). This strategy of “fine-slicing” is enabled by technological advancements, such as the internet and other communication technologies, to allow control at a distance (and without ownership) to become possible even for elements which require reasonable control (Buckley, 2009).

The GF is concerned with key aspects around cooperative relationships, contractual agreements, competitiveness, governance and coordination, as well as corporate social responsibility (Buckley, Enderwick and Cross, 2018). Blockchain has the ability to impact these areas and significantly improve SCM. This becomes particularly clear when placing a definition of SCM alongside the features of the GF combined with blockchain. SCM can be defined as “the process of managing relationships, information, and materials across enterprise borders to deliver enhanced customer service and economic value through synchronized management of the flow of physical goods and associated information from sourcing to consumption” (Mentzer et al., 2001).

Thus, by taking this definition and applying it to blockchain, it could be argued that blockchain can improve the process of managing relationships, sharing information, and transporting materials across enterprise borders, which subsequently should deliver enhanced customer service and economic value through the synchronized management of the flow of physical goods and associated information from sourcing to consumption, through one single source of truth via a shared distributed ledger which can be viewed in

real-time and is immutable. This could bring many benefits, such as improved productivity, lead-time reductions, and reduced transaction costs, as well as enabling cooperative relationships to be built with greater ease, to name a few.

Therefore, blockchain directly relates to, and has implications, for the dynamics of the GF in three key areas, which the above concepts tie in to:

- i) Internalisation versus externalisation*
- ii) Location*
- iii) Coordination of the network*

## **2.5 Research Gap**

Whilst there has been some research into blockchain within SCM, there is no work that directly addresses the issue of how blockchain impacts relationships between different actors within a supply chain and how relevant academic concepts such as the GF are in explaining this impact. This is the gap this research intends to fill.

### **Chapter 3: Methodology**

This chapter addresses the methodology behind this research and follows the Research Onion model (Saunders et al., 2015). It outlines the research philosophy and approach to theory development, details the methodological choices made, and research strategies undertaken in data collection and subsequent analysis.

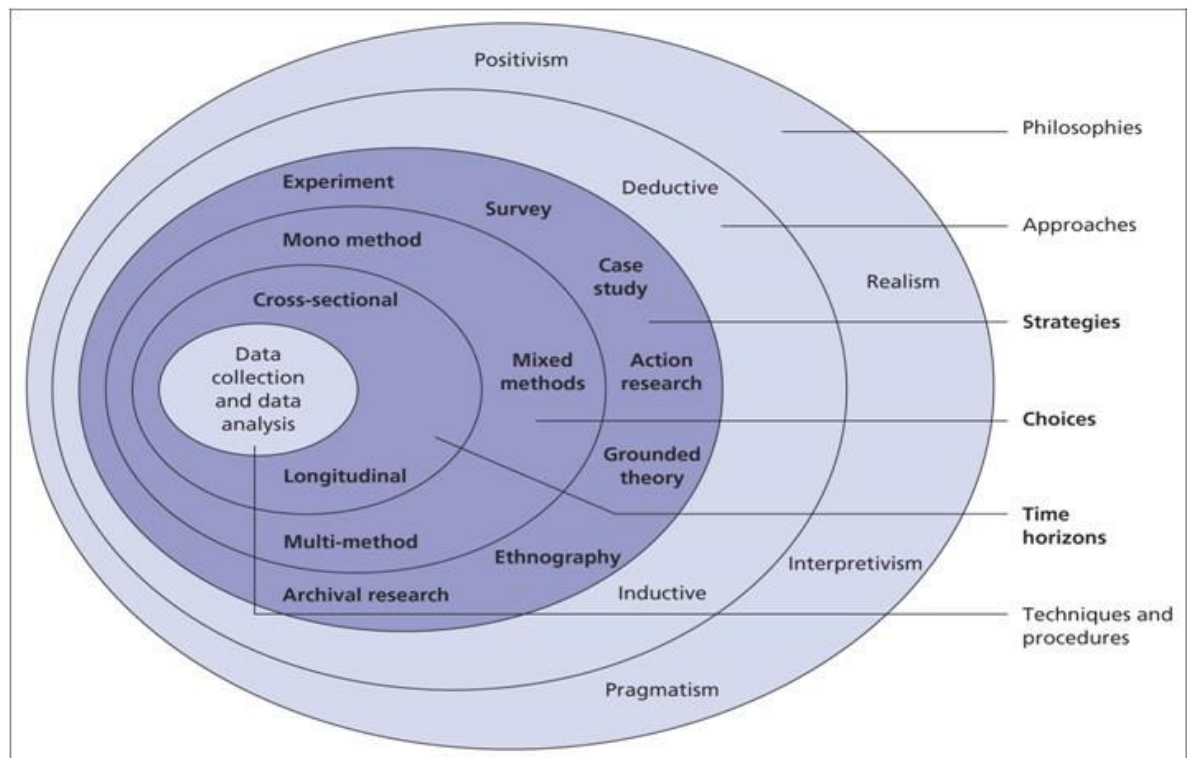


Figure 5 - Research Onion model (Saunders et al., 2015).

### **3.1 Research Philosophy**

A research philosophy shapes an individual's understanding of their research questions, the methods employed, and how findings are interpreted (Crotty, 1998). Each research philosophy represents distinctive ways of viewing reality, forming unique and valuable contributions (Morgan, 1986).

### 3.1.1 Ontology

Ontology concerns our assumptions about the nature of reality (Saunders et al., 2015), and whether social entities exist separately from researchers and participants (objectivism) or whether social phenomena is formed from the interpretations and consequent actions of individuals (subjectivism).

For this research, I will view blockchain through social constructionism - reality is created through social interaction, but that actors will perceive different situations in subjective ways. Thus, many factors experienced by organizations using blockchain are common, yet individuals' opinions will be context-specific.

### 3.1.2 Epistemology

Epistemology concerns our assumptions about knowledge, what makes knowledge acceptable and how this is communicated to others (Burrell and Morgan, 1979). Some research will take a positivist approach and explore causal relationships to create law-like generalizations (Gill and Johnson, 2010). The methodology used will be highly structured to facilitate replication (Saunders et al., 2015).

Other research may take an interpretivist approach which believes meaning is created by our interpretation of physical phenomena (Gray, 2014). It is these meanings which are studied, rather than the phenomena themselves. This is challenging and creates an axiological implication (Saunders et al., 2015), since the researcher's own beliefs and values may influence the construction of a meaningful reality (Rowlands, 2005).

My research undertakes an interpretivist approach; it seeks to understand the world of the participants being investigated and draw meanings from their experiences to explore how relationships are being affected. This will enable an overall analysis of the role blockchain is playing in the GF.

### 3.1.3 Approach to Theory Development

There are three forms of research approaches. A deductive approach often begins with a hypothesis before any data is collected and emphasises causality. An inductive approach collects data first and then generates theory. Whereas an abductive approach collects data

to explore a phenomenon and identifies themes and patterns which are located in a conceptual framework and consequently tested (Saunders et al., 2015).

An abductive approach moves back and forth, moving from theory to data and data to theory, combining both deduction and induction (Suddaby, 2006). Van Maanen et al (2007) highlight that surprises can occur at any stage in the research process, even at the writing stage of the report.

My research follows an abductive approach, obtaining data in sufficient and rich enough detail to explore blockchain technology in the supply chain and identify and explain themes and patterns regarding the impact on relationships between different actors. These explanations are then integrated into an overall conceptual framework (the GF), thereby building up a theory of the impact of blockchain in SCM. This will be tested using evidence provided by existing data and new data and revised as necessary.

## **3.2 Research Design**

### **3.2.1 Methodological Choice**

Researchers have the choice between using either quantitative data, qualitative data, or a mixed methods approach. A qualitative research design is often associated with an interpretivist research philosophy (Denzin and Lincoln, 2005) and is particularly useful for research where little is known about a phenomenon, or to gain new insights on existing knowledge (Strauss and Corbin, 1998). Thus, given the state of blockchain technology and its application to SCM, qualitative data collection is the best means of understanding this new phenomenon.

Saunders et al. (2015) outline four different ways research can be designed: exploratory, descriptive, explanatory and evaluative studies. This research is underpinned by two purposes:

- *Exploratory*: seek to explore what is happening and ask questions about it to gain insights about a particular topic
- *Explanatory*: establish causal relationships between variables



On the one hand, my research will undertake exploratory research; it seeks to explore what impact blockchain technology is having within SCM. Additionally, this research is also designed with an explanatory purpose; I will be studying how blockchain is impacting the relationships between different actors, both in relation to and as a result of different variables.

### 3.2.2 Research Strategy

Research strategy is the methodological link between research philosophy and the methods chosen for data collection and subsequent analysis (Denzin and Lincoln, 2011). My research will follow the research strategy referred to as Grounded Theory in the data collection process.

Glazer and Strauss (1967) developed Grounded Theory as a response to extreme positivism. It is used as a “process to analyse, interpret and explain the meanings that social actors construct to make sense of their everyday experiences in specific situations” (Saunders et al., 2015). It is particularly appropriate for an abductive approach, since it arguably moves between induction and deduction (Strauss and Corbin, 1998). Suddaby (2006) identified a key misconception about Grounded Theory – the belief that research should ignore the literature until later into the project.

For my research, a comprehensive literature review was conducted before collecting data to understand the phenomenon and used Grounded Theory only as an approach to analyse the data and generate/discover a theory. In fact, the first level of analysis uncovered various different theories which were first examined to utilise and apply to blockchain technology, for example Transaction Cost Analysis, Principle Agent Theory, and Network Theory. However, my research view evolved during the process after further reading and data exploration, which uncovered the GF model as a better framework to apply to blockchain technology in the supply chain.

In terms of coding, this research will follow the coding manual by Saldaña (2013) which describes coding as a cyclical act. Thus, as the researcher codes and recodes, the codes and categories become more refined and due to the chosen methodological approach, will become more conceptual and abstract (Saldaña, 2013).

During the First Cycle, coding processes can range from a single word to a full paragraph. In the Second Cycle, the codes can remain the same, become longer or shorter, or even reconfigured. Some categories may contain clusters of coded data which need to be further refined into subcategories. This process enables the researcher to transcend the “reality” of the data collected and progress toward the thematic, conceptual, and theoretical (Saldaña, 2013).

Once this stage is complete, a thematic network will be constructed, using ‘Basic Themes’, ‘Organizing Themes’ and ‘Global Themes’ to illustrate the relationships between various codes, which will be represented in web-like maps (Attride-Stirling, 2001).

- *Basic Themes*: lowest-order premises evident in the text
- *Organizing Themes*: categories of basic themes group together to summarize more abstract principles
- *Global Themes*: super-ordinate themes encapsulating the principal metaphors in the text as a whole

Figure 6 illustrates this process of coding the researcher aims to follow.

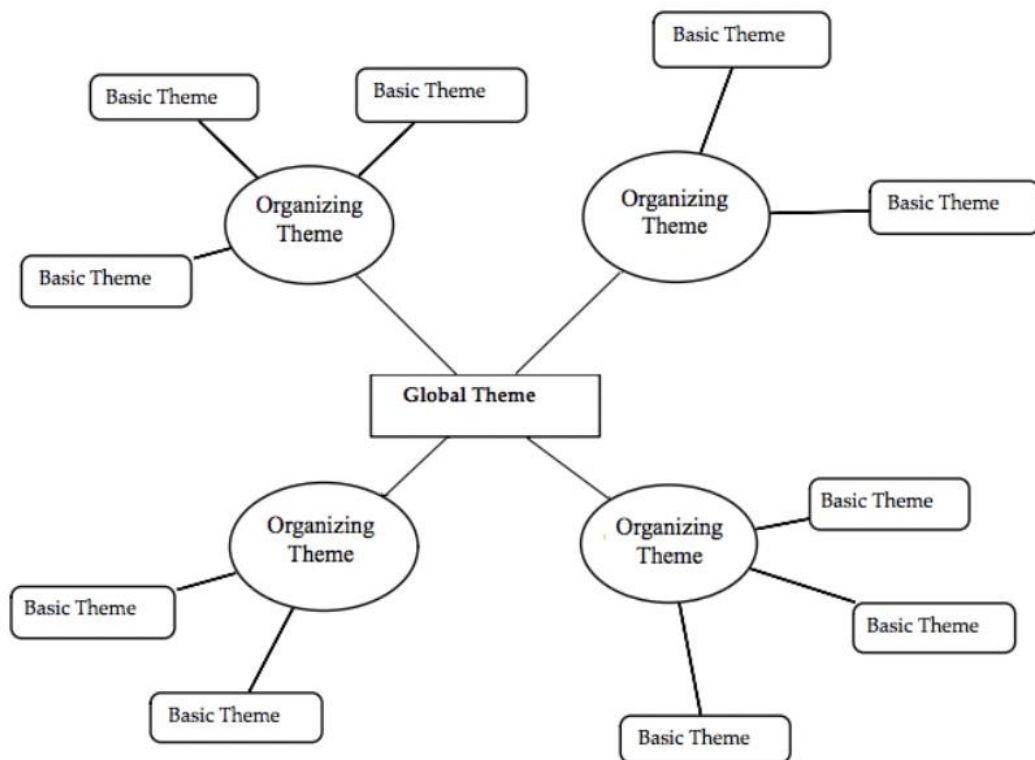


Figure 6 - Structure of a Thematic Network (Attride-Stirling, 2001).

### 3.2.3 Time Horizon

This research will be conducted in the space of three months and therefore, due to time constrictions and limited resources, will adopt a cross-sectional approach.

### 3.3 Data Collection and Analysis

The methods used to collect and analyse data are influenced by the decisions made in the previous steps of the research design. For my project, the interpretivist and abductive nature of the research, as well as the choice of research strategy has guided me to collect data via semi-structured interviews.

Interviews were chosen as a method of data collection over other methods such as questionnaires because of the level of interaction between researcher and participant. Structured interviews were regarded as too rigid for the purpose of this study and unstructured interviews as not providing a solid framework to ensure all aspects are covered. Whereas semi-structured interviews can be structured around the key concepts the researcher wants to address with participants, whilst enabling probes into interesting comments which may emerge during the interview. This will aid the researcher

understand ‘what’ the impact of blockchain technology in the supply chain is and ‘how’ this affects the relationships between various actors. This will enable theory to be generated/discovered as to ‘why’ this is the case. Thus, for my research, it will enable an analysis of how the GF model works alongside blockchain and discover if the hypotheses around the theory support what is occurring in the ‘real world’.

The interviews will follow the same overall structure. The initial discussion will begin with settling questions to create a relaxed atmosphere and develop a positive relationship with the interviewee. The table below indicates the settling questions I will use.

Settling question 1	Could you tell me a bit about your current role in the supply chain?
Settling question 2	In what ways are you exploring blockchain technology?

*Table 1 - Settling Questions.*

Although, due to interviewees having different backgrounds and roles in SCM, the questions asked may differ depending on the participant. One element that will remain constant however is that the list of general question areas the researcher hopes to address will be sent to each interviewee beforehand, thus enabling more insightful discussions.

Moreover, the design of interview questions will be guided by two components: drawing from existing papers in the blockchain literature which highlight the need for certain aspects to be explored<sup>4</sup>, alongside key concepts drawn from the theory of the GF.

Therefore, the questions are designed to explore how blockchain could impact these aspects. This will guide the approach for data analysis, which will analyse the information collected and discuss the key themes through the lens of the GF model to discover how actors’ relationships are being impacted.

### 3.3.1 Participant Selection

Participants were selected for this research by their level of exposure to blockchain, as well as their roles in SCM. The researcher focused on individuals in either high-level management or who possessed significant expertise in blockchain, since the GF model is concerned with how changes in the international business environment has fundamentally

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<sup>4</sup> For examples see: Treiblmaier, 2018; Cole et al., 2019; Wang et al., 2019; Bateman, 2015.

changed the decision-making process of managers today (Buckley, Enderwick and Cross, 2018). Overall, 33 participants were interviewed (Appendix 1).

### **3.4 Ethical Issues**

Informed consent was the key ethical consideration for this study; each participant was given an information sheet and consent form prior to starting the research. Participants were informed they could withdraw their data at any point before September 5<sup>th</sup> (when the project had been completed) and could stop the interview at any time if uncomfortable.

## **Chapter 4: Findings and Analysis**

### **4.1 Introduction**

This chapter begins with a thematic analysis of the main findings from the interviews conducted, which is followed by a discussion of how these findings interconnect and relate to the research questions stated at the start of the research and concludes with some recommendations for future research.

### **4.2 Thematic Analysis**

Analysis of the interview data collected led to the identification of various different key themes. I identified 4 grand themes that were shaped and informed by 15 organizing themes and 49 basic themes (Figure 7).

Discussion of the key topic areas will be structured by the grand and organizing themes identified, with the basic themes specifically mentioned where they add to the understanding of the relevant topic.

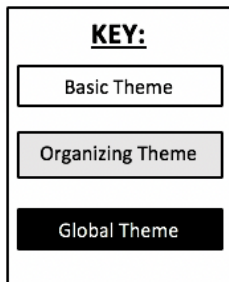
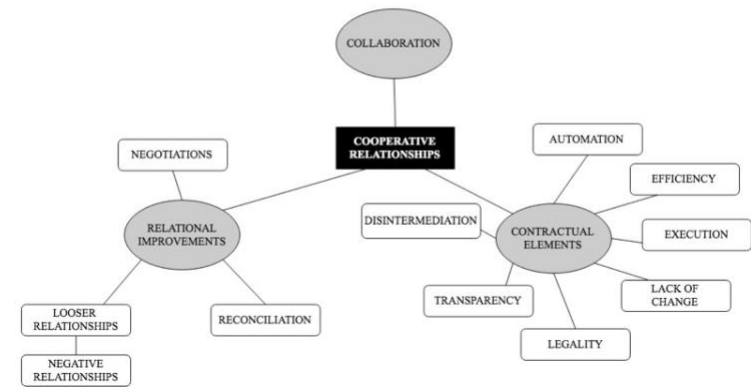
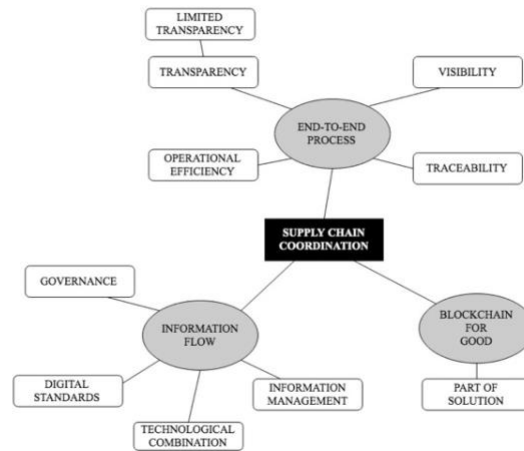
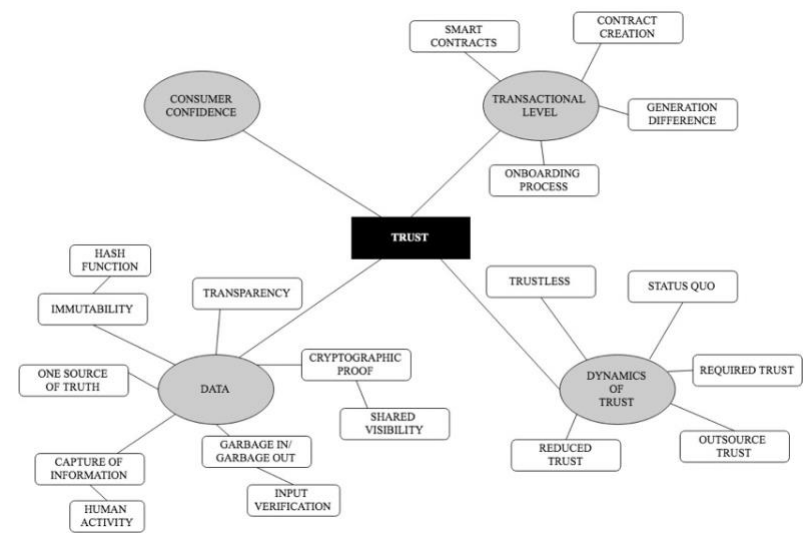
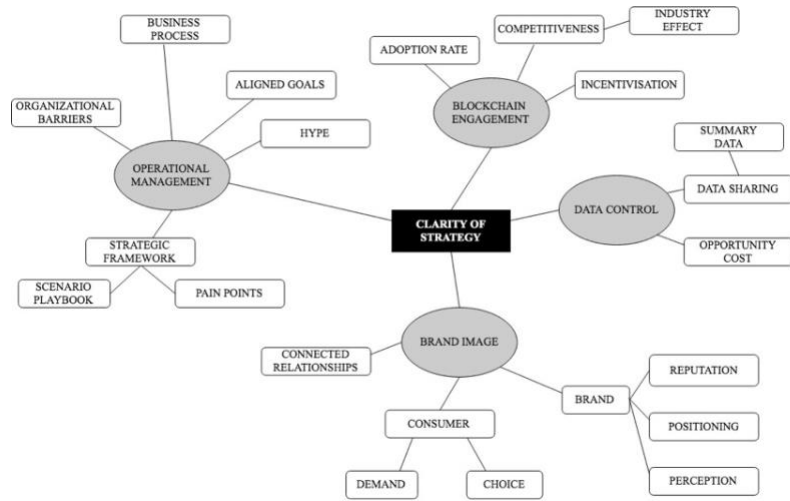


Figure 7 - Thematic Analysis Codes.

#### 4.2.1 Clarity of Strategy

Thematic analysis of the interview data revealed that clarity of strategy is fundamental for organizations – this was a very broad theme encompassing several different yet interconnected elements. Firstly, there was a clear theme around operational management and the need to consider strategic frameworks, thus identifying pain points in current processes to design a strategy for blockchain implementation. One participant remarked:

*“Before we use blockchain or any other technology, there has to be a framework of the action plan and the strategy. Without the framework, any technology including blockchain is useless.”*

This same participant went on to say:

*“It’s always the problem first and then technology. Why do we need it? Always the question of what is the actual problem we are trying to solve? Do we actually need it?”*

Participants also generally agreed that organizations need to have aligned goals and adapt their business processes to reap the benefits of blockchain. Current business processes are too rigid and old-fashioned and need to be adapted or reinvented, which may take time to change. To quote one participant:

*“I always say to people, if your goals are aligned then the technology really shines and allows true collaboration. But you have to go into it with the right intent...you both have to go in understanding that you’re going to share the data and you’re going to work together to improve overall performance and make the business relationship work for both parties”*

A few participants built on this with regards to organizational inertia inhibiting the ability to share data. Many organizations work on an old set of structures and mantra based on data privacy, as opposed to a shared ecosystem. One participant stated:



*“So, to get their heads around what it means to their business by sharing processes and sharing databases and having trust, is the biggest thing that is going to slow down the adoption of blockchain. Our reptilian brains can’t really get our heads around it. It takes time for organizational change to catch up with the technology.”*

There was also a clear theme around blockchain engagement, specifically in relation to incentivisation and competitiveness. Participants generally referred to three main ways to motivate actors to get onboard a blockchain network, either through institutional pressure, education, or through the desire to work in a cooperative model. Currently, the first-adopters are tending to mandate their suppliers to use blockchain; however, in other scenarios it comes back to the issue of pain points and the business use case.

Additionally, a few participants referred to the brand image of an organization. Consumers today are demanding more and more transparency and are increasingly concerned with the provenance of the products they buy. Thus, some participants referred to the enhanced brand reputation and subsequent relationships with consumers created by implementing blockchain. The following quote encapsulates this idea:

*“Very soon trust will be moving from the voluntary to the mandatory which will exactly result in not just efficiency of business, but the legitimacy of the business. It will result in quantifiable PR and not just reputational risk, it is actually going to be operational, revenue and legal risks.”*

#### 4.2.2 Trust

The concept of trust was a common theme that emerged from the analysis of the interview data – this section looks at how blockchain could revolutionize the way trust is conceptualized throughout the supply chain from various perspectives.

Perhaps the strongest finding was that the trust of data will be significantly increased, but there are still underlying issues at the heart of blockchain. A number

of participants referred to the concept of ‘garbage in, garbage out’ – that blockchains are only as good as the information inputted, and so it requires honesty from an input level. Participants strongly agreed that there needs to be systems in place to verify the information inserted on to a blockchain. This is covered further in section 4.2.2 under technological combination. Two quotes demonstrate these comments:

*“I think companies who will use blockchain really need to make sure that they have ways of cross-referencing and cross-checking or making sure that the human error is reduced to the minimum”*

*“If you put truth in the system and truth goes through the system, then everything is perfect. If you cheat the system then you put the lie on the system, it’s a distributed lie...it will be better than the situation we have now nonetheless. The supply chain now can be cheated on many points in the system. If you implement blockchain, it might only be able to be cheated by the oracles.”*

Participants agreed that data becomes increasingly trusted due to a few key characteristics, in that blockchain provides cryptographic proof, through one source of truth, which gives greater transparency, as well as security due to its immutable nature. A key distinction was made between proof being a piece of evidence, which can then be used to build greater trust, due to the quality of immutability. To quote one participant:

*“Blockchain is giving companies cryptographic proof of a set of facts and ensures they can’t be tampered with. That proof then helps engender trust in the network.”*

Related to this was an agreement by participants on the significance of blockchain providing one source of truth, as opposed to two versions of the same record by different organizations, thus removing data siloes in the network. Organizations can have shared visibility into the same data set, creating an aligned system and removing to a large extent issues around miscommunication or data tampering, since it immediately takes out any interpretation. To quote one participant:

*“It’s a kind of convoluted terribly reconciled system, that’s our status quo and we are trying to get to that one single source of truth solution with blockchain. So, we still have a very brittle, very broken, very dispersed system. It’s working to a certain degree but there is an immense amount of efficiency which could be gained if you have an aligned system across the entire ecosystem.”*

A related theme was the dynamics of trust. There was strong sentiment amongst participants that trust would be impacted by blockchain, however these sentiments differed slightly. Some believed trust would either remain at the status quo, be reduced or become ‘trustless’; others thought greater trust would be required, referring back to data input issues. These mixed thoughts were essentially all due to the fact that trust becomes, to a large extent, outsourced to the technology.

This highlights another theme– trust at a transactional level consequently is impacted due to potential shifts in the dynamics of trust. A few participants remarked that blockchain could help enable the process of transactions, particularly small ones, to take place with less due diligence. One participant summarizes this view, drawing on the impact of the Internet for seamless communication with no geographic barriers:

*“Imagine if we could do something similar for assets and transactions. Being able to transact with anybody without any barriers, that’s really the problem blockchain is aiming to solve.”*

This has an added benefit in the onboarding process of suppliers. Participants agreed that performance trust will be affected due to trusted data and changes in the dynamics of trust, coupled with the role of smart contracts, which combined provides greater certainty for contract execution and payments. This will be explored further in the next section. To quote one participant:

*“It will completely change the relationships. The contractual trust will not be needed. You will remove the need for it.”*

### 4.2.3 Cooperative Relationships

The ability to build cooperative relationships was a central theme identified from the interview data. There was strong agreement that blockchain would create an environment for collaboration and has the capability to bring business networks closer together than ever before. In particular, it promotes relationships beyond the traditional one-up, one-down interactions which exist today. The two quotes below illustrate this:

*“I could take a step back and have network wide dashboards that help you run the business, versus kind of going back to the transactional kind of blind way in which we do business today...it’s really a way to transform the way companies work together.”*

*“It has the potential to unravel the corporate veil and build relationships across the network, which is better than what we have now in terms of a lot of uncertainty across these boundaries”*

Participants also largely agreed that contractual elements will be affected by blockchain. Smart contracts will impact traditional contractual relationships due to certain processes being automated which reduces human intervention and could change the nature of how value is exchanged between parties. Participants further agreed that the execution of contractual agreements will change, since there will be shared implementation as opposed to two different systems, which provides greater certainty.

There was also strong agreement that the change in dynamics around contractual agreements could lead to disintermediation and reduce transaction costs, consequently increasing efficiencies, a concept which is highlighted widely in the literature. One participant explained this aptly:

*“It is causing businesses to think carefully about what the intrinsic value they add is in a business network...if the value that you add is merely taking that input unchanged onto an output and so you are just passing that input onto the output*

*and not adding intrinsic value, then you are liable to have disintermediation if the dynamics of the network change.”*

A number of participants highlighted that relations would be improved between organizations, due to the increased collaboration and change in contractual elements. Firstly, some participants alluded to an impact on the negotiation processes, indicating that blockchain could be used as a negotiation tool in various forms depending on the context. However, one participant made an interesting comment regarding the traditional system being static in nature and advocated that blockchain could provide a more dynamic, proactive system, which would lead to operational efficiencies and reduced delays. The following quote explains this sentiment:

*“We have multilateral communication in the near real-time, rather than just in a reactive way. Here it happens in a proactive way.”*

Further still, many participants cited the inherent capability to reconcile with greater ease due to blockchain. Currently, reconciling is very manual, costly and time-consuming. It is usually done through phone calls and emails, with organizations having different information sets. One participant stated that it is people who act as “the facilitator of trust in those connections between organizations”. However, this could become more efficient with blockchain, due to closer collaboration and greater visibility with shared information, which reduces the need for phone calls and human interaction and consequently, should improve business relationships. To quote one participant:

*“The technology in place, because of being able to see the information on a distributed ledger, and having that information enacted upon automatically, through utilisation of smart contracts, increases the efficiency, reduces the time and effort spent on reconciliation, reduces the friction between parties, and having to enter into disputes.”*

#### 4.2.4 Supply Chain Coordination

Thematic analysis also revealed a series of themes under the umbrella of ‘Supply Chain Coordination’ – this largely related to how blockchain helps to enable greater management and coordination of the end-to-end supply chain.

Firstly, a key finding was the improvement in managing end-to-end processes. A number of participants agreed that the traceability piece of blockchain will help both operational management and efficiencies within the supply chain, albeit dependent on technological combination.

The majority of participants highlighted the benefits of transparency and visibility, coupled with traceability, to improve business relationships and create new ways of doing business. One participant stated that “access to information becomes global, open and of course digital and that is the biggest advantage of blockchain”. It will shift the dynamics in terms of accountability between different parties due to shared visibility and real-time information, which should lead to better relationships. The quote below encapsulates the shared sentiments:

*“If we can basically optimize the supply chain by using blockchain technology, by adding transparency, and it’s also adding trust and traceability, in that sense, I think you are kind of optimizing the cost of basically providing a solution.”*

This alludes to another shared response by many participant - operational efficiencies increasing. The characteristics mentioned throughout the Findings Section culminate in optimization of overall business processes and saves costs and time. One participant stated, “the faster the process of communication, the more agile or more efficient business can be.” Another participant expanded on this:

*“Blockchain is really about making sure you trust your data. And if you can trust the data, then you can plan better, and if you can plan and orchestrate better you will get efficiency gains. And the more efficient you can make supply chains, the more you take slack out of the system.”*

There was also a clear theme around the control of information flow between different stakeholders. Many participants agreed that blockchain enables companies to proactively manage their supply chains and deal with the complex nature of supply chains, thus improving the ability to coordinate the network. The two quotes below illustrate this:

*“It’s a technology platform that can help companies validate and monitor their operations.”*

*“So, what it does is really bring a spotlight and a mechanism to enforce your rights, which we didn’t have in the past.”*

Although, participants remarked that whilst blockchain is a great tool and will revolutionise how data is managed and shared, it requires technological combination. For example, IoT devices combined with blockchain was voiced by most participants, reducing human input and increasing the verifiability of data, as well as the ability to trace and track assets to increase the provenance of goods. One participant summarised this:

*“So, the ultimate goal is to start to add these other devices in, so that we can actually monitor the cold chain, as opposed to just logistics touch points.”*

Related to information flow is the issue of governance – the rules set up by the users and participants of the network. A number of participants highlighted this, particularly around the level of transparency and visibility into the network which can be restricted. A few participants made this distinction, with one participant stating blockchain will “create trust and traceability, but not necessarily transparency, because the information is not going to be available to everybody”. Many participants shared the sentiment that business blockchains would run through a permissioned blockchain, which requires a governance model. To quote one participant:

*“When you are creating any type of blockchain network, it requires a whole set of architectural discussions between the participants of the network. So, you have*

*to decide how you want the system to look, what governing structures will be in place, decide what you want to share and who to share it with.”*

However, participants were also clear that there would need to be digital standards in place to enable blockchain to reach its potential. The necessity to speak the same language when capturing and sharing information is fundamental in creating shared value.

This concludes the key findings of this research – the next section discusses how these findings related back to the aim of this research and the research questions presented.



# BLOCKCHAIN IN THE SUPPLY CHAIN

FINDINGS

**1** | **CLARITY OF STRATEGY**

This is the first step of any business solution. Organizations need to understand what the pain points are in their current processes and ensure their goals are aligned when it comes to the implementation strategy, for example what data will be shared. Moreover, a plan needs to be formulated to engage different actors.



**2** | **TRUST**

The dynamics of trust will be affected when it comes to interactions within a business network. There are mixed opinions on how this will play out in the long-run, but it will undoubtedly impact trust at a transactional level.

There is agreed consensus that blockchain will have a significant impact on the trust of data throughout the value chain, although it is dependent on the input of truthful information.



**3** | **COOPERATIVE RELATIONSHIPS**

As a result of the new trust dynamics, there is likely to be increased collaboration between different actors. This is aided by contractual elements which will help automate various processes and lead to greater efficiency. Additionally, organizations will be able to reconcile with greater ease, which should lead to smoother relationships and consequently, helps to further increase collaboration.



**4** | **COORDINATION**

These three aspects together will culminate in a greater ability to manage and coordinate the end-to-end supply chain. End-to-end processes will be optimized due to enhanced visibility, traceability and transparency (and consequently more trust), which will subsequently create higher operational efficiencies. Moreover, the flow of information will be easier to manage, albeit dependent on the governing rules set up and the type of blockchain implemented.




Figure 8 - Findings Summary.

### **4.3 Discussion**

This chapter follows on from the key findings to assess the practical implications for organizations who are either using or looking to implement blockchain technology in their supply chains, through the GF model.

A crucial takeaway from the interview data was the constant interrelations between the themes – the thematic network (Figure 7) can be analysed in a clockwise fashion (Clarity of Strategy > Trust > Cooperative Relationships > Supply Chain Coordination) in which each theme has a direct relationship on the following theme. However, endless connections can be made across the themes, creating multiple layers of interrelations across the network. Therefore, whilst each theme can be isolated and analysed individually, it would be wrong to not consider the whole network due to its intertwining nature.

#### **4.3.1 The Control Decision: Internalisation or Externalisation?**

The findings of this research indicated that blockchain makes it easier for an organization to externalise activities. This reinforces themes in the literature that suggest the characteristics of blockchain increases transactional and relational trust, and combined with lower transaction costs, enables organizations to use resources on the outside with the same ease as resources on the inside.

Firstly, this is based upon the trust factor with regards to the characteristics of the data and the change in dynamics around relational trust. If you now can remove a large chunk of the trust – a fundamental element for transacting in the business environment – and place this in a technology that is characterised by its immutability, providing cryptographic proof and one source of truth with shared visibility throughout the network, arguably there will be no need to place as much trust in other actors. This has the potential to reduce the time required in the onboarding process of suppliers, as well as reducing the ambiguity businesses face during transactions in an international environment. It will transform the siloed, inefficient systems used today, and should lead to smoother business relationships. Therefore, if you have this increased trust in the system, coupled with real-time shared visibility and more reliable data, you should be more likely to outsource activities if costs will be minimised. It could for example facilitate transactions which

may have previously been seen as risky, since trust could be established through blockchain.

Although, there is debate around the verification of the inputted data. Despite the potential challenges around the trust of truthful data being inserted, you have the added benefit compared to traditional systems of visibility as to where the data was either incorrectly inserted or falsified. This again means you can potentially outsource activities with increased confidence since you can identify the step in the chain which was accidentally or purposefully manipulated and have the capability to resolve it quickly due to the audit trail of evidence visible to all actors.

Secondly, there are contractual elements which help externalisation. The aspect of disintermediation means you can store and exchange value without the need for traditional intermediaries if they are not adding any additional value along the chain. This will reduce transaction costs and lead to increased efficiencies. Additionally, smart contracts increase the confidence for an organization due to the ability to confirm when a process has been completed, and the automation of payment based on the completion of activities. This further reduces the need for human intervention and helps organizations outsource activities with increased assurance around contractual agreements.

Therefore, organizations should be able to externalise with greater ease due to higher levels of trust and lower transaction costs, but also crucially have the ability to control these activities better without owning them and from a distance, due to the transformational characteristics of blockchain. This links to RQ2 around the aspect of location choices.

#### 4.3.2 How Are Location Choices Impacted?

Blockchain will impact the location choices of activities for organizations. It facilitates organizations to control activities from distant locations and without the need for ownership. The findings coincide with the previous literature and highlights that the increasing complexity of supply chains and distance between activities has created managerial challenges involving a number of pain points in the supply chain, which blockchain could help solve.

Firstly, blockchain will bring business networks closer together and transform the traditional 'one-up, one-down' relationships. It will help demystify the complex and disconnected nature of supply chains, enabling greater collaboration despite physical distances. Thus, blockchain can help organizations transcend organisational and geographical barriers, transforming the traditional convoluted and reactive system into a dynamic, proactive system. An asset can be tracked along the whole chain, in real-time and with a shared view, combined with technologies such as IoT sensors, providing organizations provenance from point of origin to point of consumption. Therefore, organizations don't have to be as near to locations to 'control' the activities – blockchain provides a tool to visualize every step of the chain from any location – and this increased visibility and transparency of the whole process will transform how companies work together.

Moreover, participants also agreed that reconciliation costs would be significantly reduced. The time and cost of phone calls and emails coupled with different information sets when errors occur lead to inefficiencies, delays and administrative headaches for parties involved. Blockchain has the potential to reduce these communication costs and inefficiencies within the chain, reducing the manual labour involved and improve business relationships, due to greater collaboration and shared visibility of operations. So, when errors occur there will be less friction between parties due to greater accountability throughout the chain resulting from the characteristics of blockchain – traceability, transparency and ultimately higher trust. It removes the requirement to trust the word of others since there is now cryptographic evidence which indicates where the responsibility lies when errors do occur. Therefore, this helps to overcome the problems of distance, enabling greater control of the activities and assists in reducing fundamental issues faced by companies who work with actors located globally.

Participants also generally agreed that organizations can now transact without barriers, building on the impact of the Internet. It potentially becomes easier to trade or interact with unknown parties or organizations on the other side of the world, particularly for small transactions which may require less due diligence, due to increased trust. It may be less risky now to engage with new suppliers, thus enabling the efficiency of the procurement processes. For example, rather than spending a few months developing a working relationship with a potential supplier, blockchain could theoretically enable

organizations to interact almost immediately with the change in trust dynamics, audit history and proof that blockchain generates.

Therefore, blockchain helps to reduce the negative impact of globalisation and gives organizations back elements of control which were perhaps restricted or diminished by the dispersal of activities around the world. The problem of distance becomes more manageable through blockchain, giving organizations the capability to manage and control their network with greater ease than traditional systems. This links to RQ3 for the coordination and orchestration of a supply chain network.

#### *4.3.3 The Coordination and Orchestration of a Supply Chain Network*

The findings implied that the overall coordination and orchestration of a supply chain network would be significantly enhanced and creates a better way of organising an external network. This study's findings strengthen arguments from the previous literature which contend that blockchain will help organizations to monitor their network in profoundly new ways and will transform the way companies interact. Interestingly, this study extends the "Triple 'T' framework" that was designed by the researcher (Figure 4) and underlines the importance of these key characteristics for the overall coordination of the network.

The blockchain and supply chain experts agreed that the end-to-end processes would be greatly transformed. Organizations will have improved traceability throughout the whole chain, which will be augmented by technological combination as highlighted in RQ2, enabling activities to be monitored at every point in the chain that is connected with e.g. IoT devices. This, when combined with the increased transparency and visibility which will provide a network wide view of operations as opposed to unique organizational perspectives, will radically transform how companies interact. It will create new ways of doing business and form better relationships along the chain. It will also provide proactive ways of coordination and reduces communication costs when tracking assets and fixing errors or delays etc. In particular, the information transported around the network will become extremely trusted, and this has a reciprocal effect of a greater ability to plan activities and orchestrate the network. This makes organizations more agile and responsive to their external environments and should enable greater operational efficiencies due to the ability to monitor and control their supply chain network with more flexibility and insight than was previously doable. Additionally, this could be

strengthened by smart contracts and the change in contractual agreements, thus reducing manual inputs and speeding up the process of verifying and executing transactions and the underlying agreements between companies, and consequently increases trust between different parties.

In fact, the very nature of companies building more cooperative relationships, combined with higher levels of trust, will facilitate greater coordination and orchestration of the network. However, participants generally agreed that this would depend on two things. Firstly, the clarity of strategy for organizations is important – companies must have aligned goals and improve existing business processes to enable blockchain to really shine. Additionally, pain points need to be identified so organizations understand where the current issues are and can subsequently implement blockchain to eliminate or reduce these aspects which stymie the ability to coordinate activities today.

Secondly, this study highlights the importance of governance and its influence on how an organization can coordinate their supply chain network. This is a key differentiator in how the coordination and orchestration of a network will differ between organizational and network levels. Participants generally agreed that companies would use a permissioned blockchain – rules need to be set up between participants of a network to understand how the blockchain will be governed. This could for example result in limited levels of transparency, which in turn affects the degree of coordination throughout the network. Thus, the influence of blockchain is dependent on the governing structures set up for the network and is unique to each business case. Alongside this, the digital standards need to be addressed to enable interoperability between different systems – without a universal language for capturing and sharing information, the coordination of information flows within the network will be inefficient.

Therefore, it is obvious that blockchain will influence the coordination and orchestration of a supply chain by enabling organizations to monitor their networks with more control and insight than traditional systems. The traceability, transparency and trust created by blockchain will transform how businesses interact and will form more cooperative relationships. Blockchain, when applied to the right use case, makes the external network more efficient, or as efficient as an internal network due to its transformational characteristics.

#### **4.4. Limitations**

A key limitation of this study is the current state of blockchain technology in its application to SCM. Most of the applications are still pilot studies and empirical evidence is limited to 3-5 years of insight. Consequently, the data collected represents opinions from participants based off trends and trajectories so far. Nonetheless, there are definite signs of its transformative potential and the participants interviewed for this study illustrated this.

Moreover, this study was conducted in a timeframe of three months and therefore further academic investigation is needed. However, this study acts as a solid foundation, and provides a strong basis for both organisations and academics wishing to conduct further research.

#### **4.5 Avenues for Future Research**

A key recommendation for future research follows on logically from the limitations – once blockchain has become more mature and there is more empirical evidence available, this research could be extended to understand how aspects have developed and played out over time. This work would also benefit from a detailed assessment of the concept of blockchain for good and how it relates to the GF model, which was outside the scope of this research. Finally, this work could be furthered by exploring a case study of one supply chain network to illustrate how relationships are impacted, and how this aligns with the framework of the GF.

This concludes the discussion section. The next chapter concludes this paper, which will relate the findings and discussion back to the main research question of this study.

## **Chapter 5: Conclusion**

This chapter will conclude this research paper; it begins with an analysis of the main research question posed at the beginning of this paper, before contextualising this research and highlighting what this work has contributed to the field.

To briefly recap, the research questions posed were:

- How will blockchain technology impact the relationships between actors in the supply chain?
  - a) How does blockchain affect the decision of internalisation versus externalisation?
  - b) How does blockchain impact location choices?
  - c) How does blockchain influence the coordination and orchestration of a supply chain network?

*Hypothesis: Blockchain will make it easier to manage distributed value chains*

The sub-questions have already been addressed in the Discussion Chapter. The main question will now be addressed, which in turn will answer the hypothesis stated.

### **5.1. How will blockchain technology impact the relationships between actors in the supply chain?**

As highlighted, it is still early days for blockchain and SCM and more time is needed to assess the impact on organizations who adopt this technology. However, evident in the findings from interview data and the subsequent discussion is the general overall theme that relationships between actors are being significantly impacted. This can be perceived in two distinct ways: at an organizational level and at a consumer level – i.e. from an internal perspective and an external perspective.

At an organizational level (internal), blockchain is impacting the relationships between actors in a few significant ways. Actors will form collaborative relationships on a much higher level than those seen today. Organizations need to align their goals and identify key pain points within their supply chain networks to pinpoint how blockchain can add value to the way they manage their supply chains. This means that organizational barriers



to sharing information will be significantly reduced as traditional ecosystems will be transformed into shared business processes with shared visibility.

This will subsequently impact the levels of trust between different actors, as one source of truth that is immutable and transparent to all parties will enable organizations to form stronger, more trustworthy relationships. Additionally, the ability to outsource a large degree of trust to the technology should theoretically reduce the need to trust others. It removes a lot of the ambiguity inherent in the traditional systems used in supply chains today, which may facilitate transactions to occur with less due diligence due to increased confidence created by the cryptographic proof which blockchain provides.

So, if issues arise it will be a lot easier for actors to reconcile with each other, or in the worst-case scenario, prove the malicious behaviour of an actor with solid evidence. This becomes even stronger when blockchain is linked with other technologies, such as IoT sensors which can be used to track assets throughout the supply chain and reduces the need for human verification and further reduces trust issues to a large extent. Moreover, smart contracts will transform how contracts are managed through the automation of payments when contractual terms are met, which increases operational efficiencies but also assists reconciliation processes.

These aspects together enable more effective management of end-to-end processes, creating open, decentralized supply chain networks. The actors involved in these networks are no longer disconnected and information asymmetry becomes history. As highlighted in the literature, blockchain transforms the way actors capture, communicate and access information (Deloitte, 2017). Actors now have the ability to trace products more effectively with the combination of blockchain and IoT; depending on the governance structures set up, the parties involved have higher levels of transparency and shared visibility into the same source of truth; and a large degree of trust becomes almost redundant in nature due to the powers of the technology.

This culminates in the ability to coordinate and manage supply chain networks with greater ease and more control. It creates higher operational efficiencies and gives organizations more flexibility, as well as the ability to manage risk better, due to the level of collaboration which was previously dormant due to old organizational mantras. This is the supply chain of the future.

On the other side, at a consumer level (external), blockchain is removing the barriers between buyer and seller, connecting the actors together which is revolutionising the way businesses operate today. Consumers are no longer pawns on a chess table, whom organizations can manipulate with false information and shield their activities from. Instead, consumers become the king, which must be protected at all times. One miscalculated move and the game could be lost. Consumers today are becoming ever-conscious and demand increasing transparency from companies, which impacts their purchasing decisions and trust of the brand. Blockchain is helping companies give consumers the demands they require and thus, the consumer is becoming more interconnected with the other actors in the supply chain. A failure to provide consumers with the information demanded could significantly harm business operations and affect profits and long-term survival.

Therefore, it can be stated that blockchain will make it easier for organizations to manage distributed value chains. Time will prove just how transformative blockchain will be, but the signs are clear. Blockchain is a powerful weapon and in the right hands could be extremely effective and change the way companies operate as we know today. It will create the global factories of tomorrow.

## **5.2 This research in context**

This research has made some very important contributions to both the fields of SCM and international business. From an academic perspective, this work extends the GF model and applies it to blockchain technology, explaining how blockchain is changing the way businesses operate today and how relevant the concepts of the GF are and how they can be used to better inform how organizations implement blockchain in the future. It provides an application to real world events via an emerging technology, and hence this is a valuable contribution of this paper.

The practical implications of the findings will assist organizations in their adoption of blockchain technology for their supply chain networks. It highlights how the relationships between different actors will be impacted and provides a relevant concept via the GF model which managers can use to help coordinate and manage their network and understand how blockchain affects key business decisions in today's fast-moving, global environment.

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## Appendices

### Appendix 1 – Interview Participants

<b>Participant No.</b>	<b>Occupation</b>	<b>Approx. Interview Length</b>
Participant 1	Enterprise Blockchain Professional - BCR	15 mins *LinkedIn messages
Participant 2	Senior Lecturer in Sustainable Supply Chain Management	35 mins
Participant 3	Academic and Lawyer	30 mins
Participant 4	Founder – Sustainability Technology	45 mins
Participant 5	Vice President – Large Blue Chip FMCG Supply Chain	50 mins
Participant 6	Strategy Director - Supply Chain Consultancy	40 mins
Participant 7	Blockchain Specialist – Multinational consultancy	35 mins
Participant 8	Managing Director – Global Public Health and Safety Organization	40 mins
Participant 9	Co-Founder – Design consultancy	25 mins
Participant 10	Former Principal and Head – Digital Platforms for Supply Chain and Procurement, Multinational consultancy	1 hour
Participant 11	Chief Digital Officer – Leading Software Company	*LinkedIn messages
Participant 12	Chief Operating Officer – Digital Health Start-up	*LinkedIn messages
Participant 13	Blockchain Strategy Lead UKI – Global IT Company	45 mins
Participant 14	Director, End-to-End Value Chain and Standards (E2E) – CGF	40 mins

Participant 15	Managing Director – niche Blockchain consultancy	*LinkedIn messages
Participant 16	Blockchain Researcher & Project Manager – Global Innovation Hub	1 hour
Participant 17	Head of Global Trade & Supply Chains – DLT/Blockchain Organisation	1 hour 5 mins
Participant 18	Business Development Manager – GTC	*Email exchange
Participant 19	Chief Strategy and Innovation Officer – Global Food Company	55 mins
Participant 20	Digital asset investment research/writer	1 hour
Participant 21	Global Blockchain Engagement – Multinational consultancy	50 mins
Participant 22	Supply Chain Executive – A Global Standards Organisation	35 mins
Participant 23	APPG Blockchain – UK Parliament	40 mins
Participant 24	Director, Supply Chain Systems and Standards – Foodservice Operator	40 mins
Participant 25	Blockchain Business Development Executive, Multinational Consultancy	35 mins
Participant 26	Deputy Executive Director – Academic Blockchain Centre	30 mins
Participant 27	Consulting Analyst – Scrum Master, Blockchain / DLT & Emerging Technology – Multinational consultancy	1 hour 30 mins
Participant 28	CEO – Blockchain consultancy	40 mins
Participant 29	Director Supply Chain – Fresh Produce Company	1 hour 13 mins
Participant 30	Procurement & Supply Chain Director – Meal Kit Industry	55 mins
Participant 31	Global Speaker and Interviewer of Major Technology CEOs	33 mins

Participant 32	Technology consultant	30 mins
Participant 33	CEO – DLT-based Identity Management Platform	35 mins

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\*\* Participants provided a typed-up response to interview questions either through LinkedIn or via Email.

## **Appendix 2 – Sample Interview Transcript**

*Could you tell me a little bit about what you do yourself around blockchain?*

Yeah, sure. So I run blockchain strategy for [REDACTED]. And so, across those strategically aligned businesses we've been focusing on investing heavily in R&D, looking at blockchains capabilities and solutions. As part of that one of the companies is [REDACTED]. So, [REDACTED] is pretty much leader in all things virtualization and cloud. So, it kind of makes us pretty well suited to actually think about what it means to create an enterprise permissioned blockchain that's truly from scratch and not something that's just bunched together, which you have a lot in the market of. So, we've been focusing the last four years specifically, on looking at consensus protocols and how to make them more scalable, specifically in permissioned environments, which we released last year.

Then in August, [REDACTED]. So open source, etc. [REDACTED] is also a contributor to the Hyperledger, and the Hyperledger projects as well. But ultimately, in the past three years, we've been doing focus on points of a consensus protocol to actually focusing on building a platform that's made for enterprise. So, it really focuses on scalability, performance and integration. For us, it's all about you know, how do you actually create an agnostic environment that allows you to run any type of smart contract language and any type of environment and actually giving you a multi-cloud environment, so being geographically and dispersed in order to really drive that decentralization. And then the other part of the business is around [REDACTED], which is an integration platform as a service. So, we released two native connectors last year, in order to basically help ease the integration between blockchain and existing applications or databases, or IoT.

So for us, it's really about, you know, how do you get from more like the pilot phase into production, because a lot of clients have had got back to us and their struggle is that what they've done with other vendors in the past is, it's great, they can prove out the actual concept of it, but they're not actually able to move from pilot to production, because actually, global scale means that you have to have a platform that's able to scale and have high performance and existing, more publicly available platforms that do that. Also, there's a security concern, in terms of like, you know, having a more advanced security components embedded.

So, I lead basically and have built the practice for [REDACTED] in the UK over the last 18 months, really focusing on our go to market. So, you know, how do we actually get solutions into our clients? And then the other part is how do we actually have a specific engagement framework, which looks at, you know, actually collaborating and co-innovating with certain parts of the ecosystem, which might be our partners, or it might also be start-ups in order to really bring that end to end experience to our clients. So that's been a majority wise that I've been doing. And I've been talking a lot as well on lots of stages, which has been interesting. So yeah that's it in a nutshell.

*Wow, that sounds very interesting! So, my first question is how do you think blockchain affects trust relationships between different actors?*

In essence, it allows different actors and stakeholders to have a far more trustworthy way of collaborating when there is no basis of trust, right. And so, let's say everything

in today's world, ultimately, you have a lot of intermediaries that have to kind of ensure that one party is trusted. So, in a big supply chain, you will always have anything that goes from the company that owns it, all the way through to basically their suppliers. However, within that whole process, there are so many different intermediaries that basically make that handover. So, for example, if you're trying to supply in China, you may not be actually registered in China. So therefore, you're maybe not liable to actually take on those licenses. So, you can get somebody who has a Chinese counterpart of that company or maybe even a franchise owner to distribute that.

But the further down you go from the supply chain, naturally, you start getting a lot of complications. So, if we think about like, alcohol market. So, if we think about any big alcohol brands, and that basically distributes their bottled content, they're having a lot of issues, specifically around parallel market, but also basically faulty content, right, of a bottle. So, that it's really easy to kind of unlock those bottles or put different type of substances in it and going with the quality and the brand value, but also put the end-user at risk, right. And so fundamentally, I think within that ecosystem, it makes it far easier to suddenly trust information because you are being able to collate all that information from a really decentralized way, but also ensuring that you can actually track and trace what is happening. Usually it's a word of mouth, or it's an email, but it's not true data. And I think that's true data and being decentralized and distributed really enables those actors to then trust each other.

But also, if we think about in a house buying process. I mean, you and I don't really know each other, I can take your word or your LinkedIn for who you are, but you might also be criminal. So, I would probably not exchange randomly X amount of money with you. I mean, even think about like, small things like Gumtree, right? You always wonder who can I trust this person? Do I want them to know where I live? I do, you know, like, so many different things. And those are for small, ultimately, like small purchases, you know, 50 pounds, but then the question about security. You now know who I am and where I live and what I do maybe. It's like do I want to expose myself and how can I basically mitigate that? And in any type of exchange process this actually starts to mitigate it, because suddenly, you have a way not only to view that information, but also to verify it. There is a truth, which is based on the historical data that's been collated into the blockchain.

***Awesome. So, would you say that increases trust or decreased the need for trust?***

So, I think the industry is really hung up on trust, and there's this word. I get it, but I always say that ultimately, whether you trust someone, or you don't, it doesn't change what they're going to do. And so, it's pretty much the same, and in my opinion about blockchain, it's like, it just actually doesn't matter whether we are increasing or decreasing it or turning it sideways. Fundamentally, actually, it doesn't matter. What matters is it inherently increases our ability to verify things, and to understand the basis of what the truth might be, you can call that trust. I just think that's a very factual way of doing things, right.

And some people may still not shop each other with a billion-dollar exchange. And mainly because they want to hedge the risk, the liability of an asset, you know, so, and I think you can turn it each way or think about, like, okay, European Union is going to, within European Commission, going to do a PoC next year - 28 member states and 2 non-EU member states, and then they're going to basically use blockchain in order to house all the national identity cards, and put that data or make it accessible to

implementing side chains into the traditional databases. Great, in essence, right? Because now we have more visibility as to who's truly crossing the borders, who's who, etc. And a lot of human trafficking will respond, etc. But think about, so each member state owns one node, which is still only 30 nodes. So sure, from a decentralization and from an encryption perspective that does protect you. But the question is, right. The question is, do we want to trust governments? And so, then the essence of trust is there again, and blockchain and the entire community that started this, you know, they're all activists pretty much, and not necessarily for any type of ownership of governance, etc, of our personal information? Right? So, I would say, really, the trust element is something that people play up. I don't think it matters so much. I think it matters more about how is implemented in order to ensure that we have more transparency.

***Great. So, then you mention the ability to track and trace what is happening. How significant is this to traditional SCM and the ability to track and trace products?***

I mean, current supply chains are extremely poor, in terms of tracking the majority of things. The food industry - don't quote me on this - but I think spends half a billion pounds each year on the issues to do with food safety because of basically individual cases of people falling sick, or maybe even dying, and that can't be traced back, and they are being sued, and need to show where actually all this stuff comes from. Right. So, there was a case, I think, last year in the UK, this girl was in Pret, and she went in and bought a sandwich looked at the back, and none of the things that she was allergic to were on the back. So she was like well that's grand, I can eat it, ate it and died. You know? And there's a big question from the parents being like how couldn't you know? But, because their supply chain is so big, and maybe there was a minute amount of ingredients, and also the regulation, right, not adhered to saying that you have to put 0.03%, whatever it is on the back of it, it only needs to be anything that's basically north of 1% of ingredients, not knowing that some people might be hyper allergic to something, and that causes them death, right. If you had an application, that would be the front-end to it, and then have RFID code that could scan and basically track every single touch point it would have had, then maybe that girl would have been saved. Again, it's an assumption. I'm not saying it's going to cure it. But, the fact that supply chains do not have like a very, like, you know, you can't go to H&M be like, yeah, show me exactly where that specific garment came from and which thread came from which part of the world? It's a problem, because how do we ensure that things are sustainable? How do we ensure that they haven't been, you know, harvested in areas of deforestation? How do we know that kids have not worked on them? You know, it's like, all these types of things because it's a global supply chain and makes it highly complex to have that visibility. But, more importantly, the end-user doesn't have that visibility. Maybe internally, they might have it, but why shouldn't we be able to have visibility as to how things are really run, right?

So ultimately, I think supply chains are hence looking at blockchain, because it's so difficult to track and trace. Now in combination of blockchain and IoT, and cloud, we're actually going to be able to track more accurately and where that all comes from or goes to. But also, there's a massive advantage in terms of cost reduction and automation as well, and digitization. If you look at commodity trading, such as oil and gas, the physical paperwork takes longer than the actual trade itself. But also, ultimately, like the shipping of goods take 40 days less than the actual physical paperwork to arrive. So, because this guy in like Japan need to sign the paperwork, then it goes with over the Middle East or wherever and whatever waters and goes into the UK, and everybody needs to sign some weird paperwork before it can be released from the port and blah,

blah, blah. Then finally everything is collated. It is not very digital process, and therefore there's an issue, that's already delaying all the shipments. So, imagine how more efficient we could be by having all the assets being tracked, but also the digital documents through smart contracts being embedded all one in one.

***So, I take two things out of that. The first one, then, is what do you think blockchains potential is in solving the issues you mentioned such as sustainability and environmental, as well as ensuring say kids aren't working when they shouldn't be?***

I think blockchains potential is based only on what us as humans in the community and the world will enable to do. It's like any technology. Technology is objective, agnostic. It can do whatever we will it to do. The question is, are we ready to actually go into our processes, our existing business models, and truly challenge them? And truly, reorganise them, re-architect them? I think that's the question. I don't think the question is about whether it has potential. It has massive potential. It has potential to completely cut out costs, to automate things, to increase transparency, to increase security, to increase control, even. However, the question is, how willing are we to really make that happen, right. And that's why regulation will create such an important part in making sure that big organizations feel comfortable with using technologies like blockchain. This is why we're doing the work we're doing at Dell Technologies, because for us, if you do not have a really scalable, and performing ultimate platform that allows me to scale globally into production, then it will be really hard for that to be adopted. So massive potential. I think it's more about are we really ready to realise that?

***Awesome, thank you that's great. And, the other point to pick up from within that is obviously, the aspects of contracts. So how do you think blockchain affects contractual agreements?***

I think, good question. I think that will depend on obviously, how will the legal system basically, allow for these contracts to be admitted into the status quo in our daily lives, right? Just to differentiate here one being smart contracts are two things. One, they act as functions. So, a smart contract can be as little as like two lines of code, which can be a function like if this happens, therefore, x y z. So, if your flight is delayed by two hours, you get £100 paid up, whatever. So, you know, it can be as simple as that. But it can also be like an actual digital contract that is then stored onto the blockchain, and then has functions embedded into that as a wider thing, right. So like, it might be an insurance policy, and that is, you know, linked to an IoT device somewhere for a farmer being like, okay if you have 100 days of jobs, then we're going to basically reimburse you \$40,000, or whatever it is and compensate you and that will automatically be paid out if the IoT device, or the weather sensor, basically, advocates that's the case.

But, I think that there's still a lot of issues if we're going to streamline judicial contracts into smart contracts, because the question is who is inputting that data, and are they skilled to do that. But also, what happens when we do not have human intervention into legal processes or insurance processes? it might go really smooth, but you know, there's always an issue somewhere, and code often has bugs. So, the question is, can we completely trust either. I think, it will again, be like if we digitize or automate a lot of these contracts or policies or functions. However, I think in terms of developing those, and constructing those, we need to be really mindful. That there needs to do standardization as well in place, so that there's a standards principle across many different layers. So, there's no ambiguity in what the code means and what ultimately, the language behind it means in terms of contractual agreements.



***That's great. Thank you. So, how do you think blockchain affects competitiveness?***

I mean there's going to be new business models, right? Already, you're seeing like crazy amounts of start-ups in this space. I mean, I think every corner you turn in London, somebody's basically doing a blockchain start-up, which a lot of them are actually not doing blockchain. They are in fact using like a concept of decentralization allegedly, in order to create something, and we have to always look under the covers - are they actually doing to blockchain or they're just using an application on top of a blockchain. So, I think it will increase the competitiveness in the start-up space, definitely, and it will allow new entrants to come into the market and streamline all of this.

However, I also think that in terms of competition amongst bigger players, you know, will be key. I think those organizations in supply chain specifically who can show transparency when it comes, for example to sustainability, will in the long-term win because a lot of society cares about that now and wants to have that transparency. And so I think, you know, like with any technology, like with cloud, you know, we had this huge burst in terms of different types of applications, name it, Amazon, or, you know, or with internet, like Uber or whatever it is, ultimately, new technologies will always increase competition, but it's also will just alleviate certain other players in order to make room for the connected the future we are heading to.

***Awesome. How do you think blockchain can change business relationships then?***

I think amongst suppliers, it could increase friction because I think fundamentally, a lot of organisations or business relations will probably be uncomfortable disclosing the majority of their business, but also in terms of making people more accountable, making businesses more accountable to each other, right?

If you are now in a supply chain, it's easy to be like, oh yeah, the goods are shipped, when it has not been shipped - I can see it on the blockchain, it has not been logged. You know, these types of things then suddenly become very aware. Or if you've shipped, I don't know, 200 KG or something to your supplier, and then suddenly it reaches the warehouse or wherever it's only 180, all these all these mischievous activities where people might be fudging things or acting malicious, suddenly become really apparent. So, I think it will shift the dynamic in terms of accountability between different business parties. And I think it will also, increase the need to mandate certain SLA's and expectations. So, I think that will dramatically shift.

I think it will also change in terms of expectations. Walmart is already basically mandating that anybody who's going to work with them will need to log it on top of the blockchain. And you know, some suppliers may not be willing, but also then there is a more practical thing, which is about, you know, some actors may not be able to, so how do we bring it up? And I say that from the perspective of we look at coffee supply chain, you know, how will farmers log without a smartphone? So, I think that's going to complicate things as well and that needs to be taken consideration. But yeah, mostly a shift in accountability I think.

***Great. You mentioned about Walmart mandating their suppliers be on a blockchain platform. How else do you think actors can be incentivised?***

That's a good question. I think ultimately, those that share and value transparency and those who run clean businesses, they will get on board anyways, because they will understand it because the values aligned to the values of what blockchains is trying to achieve. However, those players who have a problem with it should not be incentivized. Because why would you want to work with somebody who doesn't adhere to transparency? Like, who wants to hide information? Like why would you want to incentivize that? That's the point, let's exclude them, and find a way to spot them so that we no longer let them exploit the supply chain or individuals who need to work with us. That obviously will shift as well, in terms of like, will there suddenly be like, kind of how with the internet, it was kind of regulated, and then the dark web came? Will there be a dark blockchain? So, you the incentivization of things will not need to be there in terms of incentives for those players who care about the values. But I think for those players who don't care about the values, will have an inherent problem, and you shouldn't even want them as part of that. But then the real problem is not the incentivization, but it's rather, how do we actually find a way to not have a black market or parallel blockchain world exist where rogue activity takes place.

***Thanks, sounds great! You mentioned the problem of human input and making sure the data inserted is correct. In terms of practicality, how do you think this can be overcome?***

Human error will always take place. But, I think if we actually leverage certain existing data, or data sources, it might become easier. So, for example, take IoT devices, right? Ultimately, the sensors are picking up data, it might be around temperature, it might be around whether the streetlight was working at that point in time, you know, and sending that all back. It might be my movement my phone takes up is basically an IoT device, it takes my location, it understands where I am, how I am moving etc, you know, in can track my running. So, if you analyse all of that data, right, like, it's an automated thing. It doesn't lie because we actually have quantified the systems of IoT sensors to be factual. So that is one way to streamline it. I think there's going to be other things where we'll have to increase checks and balances. For example, smart contracts, that code is not faulty, so that something goes wrong, or whatever, so to mandate that. Hence, those standardisations and the governance structures will be really key. And hence why everybody wants to just create, like their own kind of universal blockchain and just wants to run one platform doesn't make sense. You need to have it agnostic, you need to have an open so that, in fact, we can have an interwoven web, where the human input actually had enough access to understand whether that is actual accurate information. But also, like, you know, digital payments, etc. I mean, those are again automated ways to track data, and transactions don't lie. That's why now some places digital only, no cash payments, because you can lie with cash, that's human input. But you can't lie with something that's gone from my phone, or my bank card into the POS system. So, I think probably more reliance on digital and digital ways to capture data.

***That's great. So, what would you say the biggest issues are at the moment?***

I think the biggest issues around ultimately, again, humans, and then wanting and are willing to basically adopt this technology. I think the actual technology in terms of scalable formats, like we're getting there, it's not so much about that. It's about the attitude of individuals to actually be like, you know, this technology can be transformative, and is essential for us to move into the future. It's still like, you know, I work in technology now for like, six, seven years - ultimately, it's always the same story, you have so many naysayers, you have so many people who just don't want

change, and it's a real problem. Because ultimately, if we can make it a fair and more transparent and more equal just society, or more sustainable society etc, why wouldn't we do it? Right? So, this is kind of a question or like, if we could create better user experiences for individuals, like why wouldn't you do that? Or better healthcare? Like, why are you preventing the world from moving ahead in a way that's actually benefiting us, and democratizing the world we live in. So, I think that's a massive challenge.

We have to look at our infrastructure as well, so if we are trying to do for example, peer to peer with cars, like a sharing economy. In order for that to happen, we need to think about that blockchain is not the only thing that needs to work, but also the integration to other systems, like existing databases, legacy systems, all the way through to next generation applications, cloud, etc, IoT devices. So, that ultimately needs to take place from a more practical point of view, but also, there's a lot of business processes that are fundamentally really archaic. I was talking to a legal client who literally said 'I just don't know what that process looks like, because we've never mapped it out. We've just always done it that way'. When that's the case, changing that means that for a global organization, means that you will probably first of all find some really nasty stuff which will need changing, and it takes a lot of work. So, the biggest job, which is also, like, actually, we architected these processes, is really difficult and it means we have to ask ourselves difficult questions. And maybe it means some things won't be feasible, you know, but then again, I think in supply chain, there's a lot of examples where you're already seeing organizations being able to use like, microbes, or bacteria on fish instead of IoT devices in order to track where those fish actually came from, so that they understand you whether it's actually over fishing in certain areas. Or, using satellite data in order to target certain areas where you might be growing palm oil so that, you know, you're not using an area where there's been deforestation, and it's killing the orangutans.

So, lots of challenges, but I think those challenges are good. It means that we ask ourselves true questions, that usually we're just accepting the world as it is, and blockchain or any other technology that's now emerging to digital, it really allows us to the question as to, you know, how can we make this possible and also on the way we discover other things that could potentially help us as humans.

***That's great, thanks. So, my final question is if you look at the main SCM pain points which exist today, particularly with food traceability, what is the promise of blockchain in solving these?***

Food safety is definitely a big one, right. I think, in terms of sustainability, so for example, we're doing something around ocean plastics, so Dell takes around 300,000 tonnes of ocean plastics out of the ocean every year. As part of that we started our first phase of a PoC this year, where we said, well, it's great that we say we're doing that and 25% in each of the trades is basically ocean and plastics. However, I'm pretty sure that the end user might actually want to know for sure that this is ocean plastic. So, how can we track and trace basically, for sustainability reasons and the origin of that plastic, that we then recycle, reuse, right? In order to actually not lie, because a lot of organizations can also lie. So, I think in terms of sustainability, that will be a massive advantage.

My view is this, okay, is that if we are able to truly have decentralized supply chain track and trace solutions out there, where not only one organization but multiple organizations, the largest fast-moving consumer goods companies in the world - if they're all in a decentralized block chain, fundamentally, right - we're going to be suddenly seeing all sorts of things. For example, maybe we're over supplying, maybe

there's internal trade that can take place. But if you think about a city like London, right, and if you think about a Tesco, or Sainsbury, Asda, you name it. If everybody had visibility of how much stock was left in real-time at any of these shops in London. Instead of being like, we need to order more chicken, maybe the area has less demand for chicken because maybe vegans live there. We can sell that food to the other parties, so that we do not over-supply, because we over-supply, that is how food waste is created.

So, think in terms of food waste, there's a huge opportunity for us to truly have visibility as to how is this all being curated? And how is it being traded, and where do we have maybe an over-supply or over-demand and why? And this way, we can then create an ecosystem or logistics, that's far more typical to a sustainable way of living rather than over consumption. So, for me, it is the promise or the idealism of what blockchain can create, because we have the visibility of what's happening in an ecosystem, right.

The obvious things for organizations will be cost reduction, great, automation, great, more efficient, awesome, you know, revenue growth, potentially with new business models, but those are business outcomes, right. But I think for humans, and the end-user, the advantage will solely lie in the fact that we're going to be able to hopefully live in a more transparent, more sustainable and fairer and more equal society.

***Awesome. Lastly, off that then, do you think too much transparency can harm business?***

Sure, but you know, too long have we lived in a society where businesses are not held accountable. Too long things have happened that still we are suffering for. For example, in West Africa and a river bed that is still not clean, because it has not been held accountable. But also, it took them so long to prove that there was actually a spillage. Too long have been the cases where people say that there is no child labour in the process, but there is. Too long have we let H&M, Topshop, Primark etc literally just use polyester, which is basically plastic, and but put on the label or gloss it over so it feels like silk. But, if you actually look on the label, it's like 65% polyester, and only like 10% silk. Too long have we let suppliers lie to us as consumers. And I don't think too much transparency can be negative as an end-user. As a business, of course. Everyone's basically shitting their pants, right? Excuse my French, but everyone's pretty terrified for the transparency, because transparency means accountability; accountability means that you're going to be held liable for the actions that you take. And in a big company, in a global company, there are just too many humans and too many actors that may do something that you cannot control. But, nothing changes. All that changes is that we now have that visibility. And I do think we need to be just a bit more accountable. Everybody is so easy and quick to turn the other way. So, I do think that transparency is really key. And I don't think there's any bad thing for it specifically.

***That's really nice and well-phrased! So, I think that pretty much covers everything. Do you have any questions for me or anything else to add?***

Not much to add except I think it's an exciting time and you've chosen a good area!

***Thanks, and thanks for your time! Have a great day!***

No problem, you too! Bye!

## **Appendix 3 – Participant Information Sheet**

### **Information Sheet**

#### **Working Study Title**

How will blockchain technology impact the relationships between different actors within the supply chain?

*I would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask questions if anything you read is not clear or would like more information. Take time to decide whether or not to take part.*

#### **What is the purpose of the study?**

I am undertaking a research project for my MSc: Business Global Strategy and Innovation Management Dissertation.

#### **Why have I been invited?**

Participants have been chosen due to their relative expertise in either supply chain management and/or blockchain technology.

#### **What will I have to do?**

Take part in an interview via skype/phone call for around 20-30 minutes. The interview type is semi-structured which will provide a focus of interest, whilst enabling exploration into aspects brought up during discussion which may be of interest to the researcher.

#### **What will happen to me if I take part?**

Data collected will be used in the formulation of my 12,000-word dissertation paper. Audio recordings will be used if permission is granted, which will then be transcribed, and relevant aspects may be used in the dissertation, either directly or indirectly referring to material discussed.

The research is due to be completed by 5<sup>th</sup> September. All recorded information will be anonymised to protect your identity and stored in a secure and private place. Data will be held for six months and then deleted. You have the right to withdraw from the research/interview at any given point.

However, once the results of the study are published and the final report has been submitted (September 2019), it will not be possible to withdraw your individual data from the research.

**What are the possible disadvantages and risks of taking part?**

There are no foreseeable risks involved.

**What are the possible benefits of taking part?**

The study will contribute to the blossoming literature around blockchain and its application the supply chain. It aims to assist academia and industry understand how blockchain will impact business operations, in particular the relationships between different actors – an aspect which has not fully been explored as of yet.

An executive summary of my findings can be sent to you on its completion if desired.

**What if there is a problem?**

If you have a complaint about the research study, then feel free to contact my supervisor [J.Palfreyman@leeds.ac.uk](mailto:J.Palfreyman@leeds.ac.uk)

## **Appendix 4 – Ethics Form**

### **Taught Student Declaration Form**

*(where FREC ethical approval is in place for the module)*

For modules LUBS5970M covered by University of Leeds ethical approval

Student ID	200945058
Your name	Robert Locke-Moulding
Provisional title/ topic area	How does blockchain technology impact the relationships between buyers, suppliers and other actors in supply chains?
Name of project/ dissertation supervisor	John Palfreyman

<b>Are you planning to conduct fieldwork with (data on) human participants for your dissertation?</b>	<b>Yes</b>	<b>No</b>
Yes (This includes online research methods and secondary data analysis).	x	
No, I am conducting library based research or content/ media analysis only.		x

***If you ticked ‘no’ you do not need to take further action in respect of ethical approval. Please proceed to the declarations on page 8 and 9.***

***If you ticked ‘yes’ you need to complete the rest of this form.***

You MUST submit your signed ethics form by to your supervisor for them to sign off.

## INTERNAL RESEARCH ETHICS APPLICATION

### Part A: Compliance with the module's block ethical approval

Ethical review is required for all research involving human participants, including research undertaken by students within a taught student module. Further details of the University of Leeds ethical review requirements are provided in the *Research Ethics Policy* available at:

<http://ris.leeds.ac.uk/ResearchEthicsPolicies> and at <http://www.leeds.ac.uk/ethics>.

<b>1. Will your dissertation/ project involve any of the following?</b>	<b>Yes</b>	<b>No</b>
New data collected by administering questionnaires/interviews for quantitative analysis	x	
New data collected by qualitative methods	x	
New data collected from observing individuals or populations		x
Working with aggregated or population data		x
Using already published data or data in the public domain	x	
Any other research methodology, please specify:		

<b>2. Will any of the participants be from any of the following groups? (Tick as appropriate)</b>	<b>Yes</b>	<b>No</b>
Children under 16		x
Adults with learning disabilities		x
Adults with other forms of mental incapacity or mental illness		x
Adults in emergency situations		x
Prisoners or young offenders		x
Those who could be considered to have a particularly dependent relationship with the investigator, e.g. members of staff, students		x
Other vulnerable groups, please specify:		

<b>3. Will the project/ dissertation involve any of the following: (You may select more than one)</b>	<b>Yes</b>	<b>No</b>



The use of, or potential access to, NHS premises or facilities		x
NHS staff recruited as potential research participants by virtue of their professional role		x
Fieldwork taking place outside the UK		x
Fieldwork taking place outside the UK		

<b>4. Will the project/ dissertation involve any of the following:</b> (You may select more than one)	<b>Yes</b>	<b>No</b>
Research participants identified from, or because of their past or present use of services (adult and children's healthcare within the NHS and adult social care), for which the UK health departments are responsible (including services provided under contract with the private or voluntary sectors)		x
Collection or use of information from any users of these services (adult and children's healthcare within the NHS and adult social care)		x
Research participants identified because of their status as relatives or carers of past or present users of these services (adult and children's healthcare within the NHS and adult social care)		x
Adults who lack capacity to consent for themselves		x
Health-related research involving prisoners		x
A social care project funded by the Department of Health		x

**If you answered 'yes' to ANY of the above questions in 2 or 3 then you will need to apply for full ethical review, a faculty committee level process.** This can take up to 6 weeks, so it is important that you consult further with your supervisor for guidance with this application as soon as possible. Please now complete and sign the final page of this document. The application form for full ethical review and further information about the process are available at <http://ris.leeds.ac.uk/UoLethicsapplication>.

**If you answered 'yes' to ANY of the questions in 4 then you will need to apply for Health Research Authority approval:** <http://ris.leeds.ac.uk/HRAapproval>.

**If you answered 'no' to ALL of the questions in sections 2, 3 and 4 please continue to part B.**

## INTERNAL RESEARCH ETHICS APPLICATION

### Part B: Ethical considerations within block ethical approval

<b>5. Will the research touch on sensitive topics or raise other challenges?</b>	<b>Yes</b>	<b>No</b>
Will the study require the cooperation of a gatekeeper for initial access to groups or individuals who are taking part in the study (eg students at school, members of self-help groups, residents of a nursing home)?		x
Will participants be taking part in the research without their knowledge and consent (eg covert observation of people in non-public places)?		x
Will the study involve discussion of sensitive topics (eg sexual activity, drug use)?		x
Could the study induce psychological stress or anxiety or cause harm or have negative consequences beyond the risks encountered in normal life?		x
Are there any potential conflicts of interest?		x
Does any relationship exist between the researcher(s) and the participant(s), other than that required by the activities associated with the project (e.g., fellow students, staff, etc)?		x
Does the research involve any risks to the researchers themselves, or individuals not directly involved in the research?		x

*If you have answered 'yes' to any of the questions in (5), please describe the ethical issues raised and your plans to resolve them on a separate page. Agree this with your supervisor and submit it with this form. Again you MAY be referred for light touch or full ethical review.*

<b>6. Personal safety</b>	<b>Yes</b>	<b>No</b>
Where will any fieldwork/ interviews/ focus groups take place?		
At the university or other public place (please specify below).	x	
At my home address		x
At the research subject's home address		x
Some other location (please specify below). Skype/telephone		

If you conduct fieldwork anywhere except at the university or other public place you need to review security issues with your supervisor and have them confirmed by the Project/ Dissertation Co-ordinator who may refer you for light touch or full ethical review. A risk assessment may also be required:

<http://ris.leeds.ac.uk/HealthAndSafetyAdvice>. Write a brief statement indicating any security/personal safety issues arising for you and/or for your participants, explaining

how these will be managed. Agree this with your supervisor and submit it with this form.

Please note that conducting fieldwork at a research participant's home address will require strong justification and is generally not encouraged.

<b>7. Anonymity</b>	<b>Yes</b>	<b>No</b>
Is there a possibility of individuals being identified or re-identified from the dissertation, either directly or by combining the information in it with other information?		X

If you have answered 'yes' to question 7, please discuss this further with your supervisor. You need to provide a strong justification for this decision on a separate sheet. This application will need to be reviewed by the project/ dissertation co-ordinator and may require a full ethical review.

### **8. Research data management**

Will the research involve any of the following activities at any stage (including identification of potential research participants)?		<b>Yes</b>	<b>No</b>
<b>a.</b>	Examination of personal records by those who would not normally have access		x
<b>b.</b>	Sharing data with other organisations		x
<b>c.</b>	Use of personal addresses, postcodes, faxes, e-mails or telephone numbers	x	
<b>d.</b>	Publication of direct quotations from respondents	x	
<b>e.</b>	Publication of data that might allow individuals to be identified	x	
<b>f.</b>	Use of audio/ visual recording devices	x	
<b>g.</b>	Storage of personal data on any of the following:		
	FLASH memory or other portable storage devices	x	
	Home or other personal computers	x	
	Private company computers		
	Laptop computers		
Explain what will happen to the data you collect once you have completed the module:			
The data will be kept securely for 6 months then destroyed.			

If you have answered 'yes' to any of the questions under 8, you must ensure that you follow the University of Leeds [Information Protection Policy](#) and the [Research Data Management Policy](#).

### Dissertation Research Ethical Approval: Declaration

For students	Please tick as appropriate
<b>Option 1:</b> I will NOT conduct fieldwork with (data on) human participants for my project/ dissertation.	
<b>Option 2:</b> I will conduct fieldwork with (data on) human participants for my project/ dissertation.	x

For **options 1 and 2** - I confirm that:

- The research ethics form is accurate to the best of my knowledge.
- I have consulted the University of Leeds Research Ethics Policy available at <http://ris.leeds.ac.uk/ResearchEthicsPolicies>.
- I understand that ethical approval will only apply to the project I have outlined in this application and that I will need to re-apply, should my plans change substantially.

For **option 2** only:

- I am aware of the University of Leeds protocols for ethical research, in particular in respect to protocols on **informed consent, verbal consent, reimbursement for participants and low risk observation**. If any are applicable to me, signing this form confirms that I will carry out my work in accordance with them. (<http://ris.leeds.ac.uk/PlanningResearch>)

Student's signature: .....R. MOULDING

Date: .....21.06.19

For supervisors	Yes	No
<b><i>No further action required</i></b>		
I confirm that the project/ dissertation is in line with the module's block ethical approval (Part A & question 7).	x	
I have discussed the ethical issues arising from the research with the student and agree that these have been accurately and fully addressed.	x	
<b><i>Further actions required</i></b>		
Refer to project/ dissertation co-ordinator for further review/ discussion.		x
The project/ dissertation falls outside the module's block ethical approval and the student was advised to apply for full ethical review.		x



Supervisor's signature:

Date: 21 Jun 19