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The future of traceability technology in the food industry

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Authors: Sara Hjelm & Simon Karlsson

Tutor: Mark Edwards

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Abstract

The food industry faces many challenges in its sustainability work, and consumers demand that companies in the food industry should increase their transparency. For the food industry to be more transparent, it must improve its traceability throughout the supply chain. Previous research let us know that traceability is not a new thing, but the way that new technologies such as blockchain revolutionize the way data can be communicated. Many companies have just started to use this to trace the supplies along their supply chain and are not using the data collected in the most efficient way. Therefore, this thesis presents data from two illustrative case studies to show the opportunities and challenges of using blockchain traceability technology. The opportunities show the benefits of being the first mover in the market to create new boosts for the products together with increasing consumer loyalty through more transparency. This paper also concludes that it's expensive to implement new technology in the supply chain and challenging to encourage consumers to make a local, organic, or sustainable choice despite the higher cost of the products.

Table of content:

Abstract
1.0 Introduction 6
1.1 Background 6
1.2 Problem formulation 7
1.3 Identified gap 7
1.4 Purpose 8
1.5 Research Question 8
1.6 Definitions 9
2.0 Frame of reference 10
2.1 Literature review 11
2.1.1 Food industry 11
2.1.2 Supply chain management in the food industry 12
2.1.3 Consumer behaviour 13
2.1.4 Consumer loyalty 13
2.1.5 Transparency 14
2.1.5 Relation between consumer loyalty and Transparency 14
2.1.6 Traceability 15
2.1.7 Blockchain traceability technology 17
2.1.8 Implementation of blockchain traceability technology 18
3.0 Methodology 21
3.1 Data collection method 22
3.2 Case selection 22
3.3 Data collection 22
3.4 Data Analysis 23
3.6 Exploration of consumer behaviour 24
3.7 Interviews 25
3.8 Interview selection 26
3.9 Ethical consideration 27
4.0 Empirical findings 28
4.1 Case Study 1 (Arla) 29
4.1.1 Marketing 31
4.1.2 Transparency 32
4.1.3 Traceability 34
4.1.4 Consumer behaviour 35
4.2 Case Study 2 (Carrefour) 37
4.2.1 Consumers of Carrefour 38
4.2.2 Marketing 40

4.2.3 Transparency and traceability 41
4.2.5 Consumer behaviour 43
5.0 Discussion and Analysis 44
5.1 Sharing of information 44
5.2 Traceability approaches 45
5.3 The role of blockchain 46
5.4 Marketing Strategy 46
5.5 Consumer Behaviour 47
5.6 Opportunities 48
5.7 Challenges 49
6.0 Conclusion 49
6.1 Opportunities 50
6.2 Challenges 50
6.3 Recommendations for further research 50
7.0 Limitations: 51
8.0 Reference list: 52
9.0 Appendix: 59
9.1 Appendix 1 59

Table of figures:

Figure 1: Research focus 7
Figure 2: Actors in the food industry 11
Figure 3: Blockchain deployment (Reproduced from Madhani, 2022) 18
Figure 4: Triangulation of Data 21
Figure 5: Process 23
Figure 6: Illustrative case study 28
Figure 7: Thematisation of Arla managers 29
Figure 8: Thematisation honesty 31
Figure 9: Thematisation trust 32
Figure 10: Thematisation blockchain technology 34
Figure 11: Thematisation consumer behaviour 35
Figure 12: Carrefour supply chain 38
Figure 13: Thematisation Consumers of Carrefour 39

Figure 14: Thematisation awareness 40
Figure 15: Thematisation transparency carrefour 41
Figure 16: Thematisation of consumer behaviour 43

Table of tables:

Table 1: Definitions of keywords 9
Table 2: Screening of the literature 10
Table 3: Interview schedule 26

1.0 Introduction

The introduction will present the research question and the main background of concepts, the purpose of the study, identified gap and the research question formulation.

1.1 Background

How a food product ended up on a shelf in a grocery store could seem to be an easy process. But it's a result of complex supply chains that most consumers lack understanding about. As more consumers demand more transparency to make sustainable choices in their everyd2ay consumption, it is important to understand the origin of the food that we eat. The food industry is aware of this increase in demand for transparency.

The food industry faces many challenges in its sustainability work, and being more transparent is one of them. For the food industry to be more transparent, they have to improve its traceability and ability to communicate traceable data throughout the supply chain from producer to consumer. Without tracing the process of a product to the shelf at the grocery store, it's challenging to present transparent information to the consumer about the environmental impact of a product. Traceability is one of the major challenges for the food industry, but as traceability technology advances rapidly and companies take advantage of innovations, it enables new solutions to increase transparency to consumers (Patidar et al., 2022). Ground-breaking traceability technology that makes use of blockchain technology enables new traceability solutions from farm to fork that can have the possibility to increase efficiency, security, and transparency along the supply chain and change consumer behaviour.

This thesis will investigate what a company can benefit from using blockchain traceability technology together with the challenges of implementing it throughout the supply chain. As seen in Figure 1, the connection between traceability, transparency, and consumer loyalty is related to each other. This paper will therefore examine the following research questions:

RQ1. "What opportunities can companies in the food industry gain by implementing blockchain traceability technology along the supply chain?"

RQ2. "What challenges can companies in the food industry face if implementing blockchain traceability technology along the supply chain?"

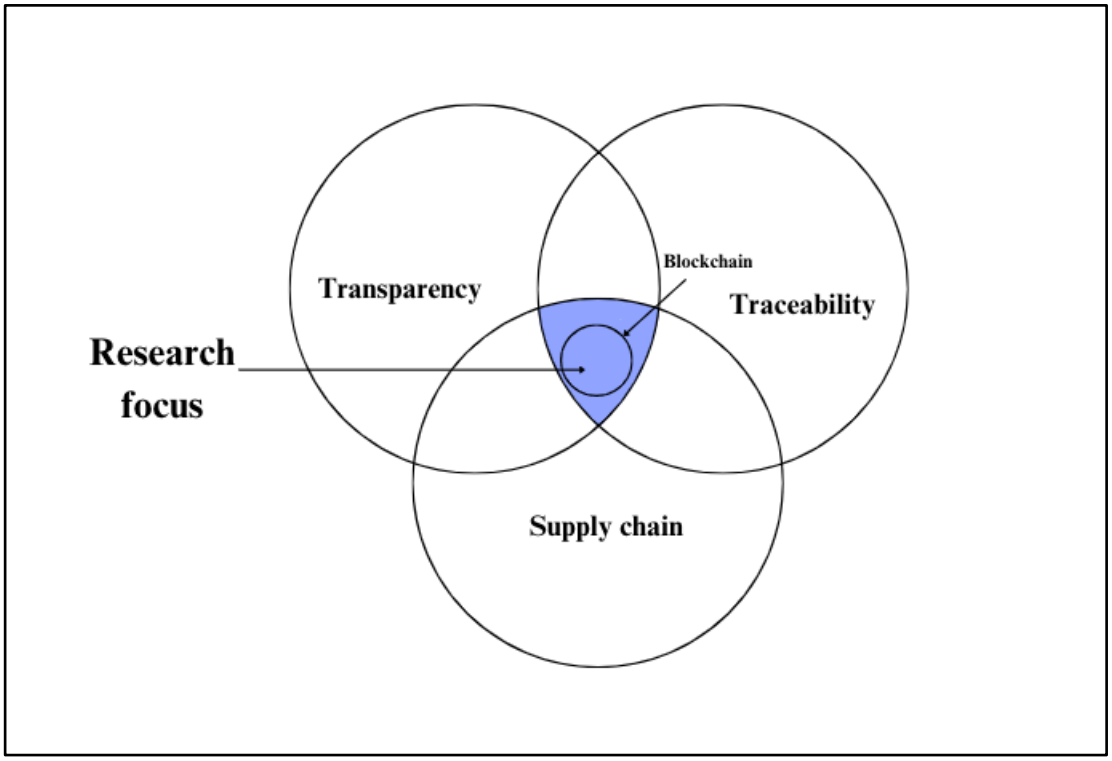

Figure 1: Research focus

The figure above shows our research focus which is the overlapping area where traceability, transparency, and supply chain connect to each other. The three different concepts are closely related and will be explained throughout the thesis. Blockchain is also a valuable keyword in between transparency and traceability that will be researched to answer the two research questions (Figure 1).

1.2 Problem formulation

New technology plays an important role in generating traceability along a supply chain. But despite that many companies are holding on to their data, most companies are not willing to share or use it to be more transparent towards consumers in their sustainability work. The problem is that companies do not seem to see the value that blockchain traceability technology can bring throughout the supply chain and beyond.

1.3 Identified gap

Traceability in itself is not a new thing, but the way that new technology enables more transparent marketing communication with technologies such as blockchain is new. Many

companies have started to use this to trace the supplies along their supply chain and have by now only a few percentages of their supply chain covered with traceability. A lot of companies have goals to be 100% traceable a few years from now, and almost everyone has a part about traceability in their sustainability report (for example, Carrefour Annual Financial Report, 2022). Blockchain traceability technology has the potential to have a huge impact on the future of supply chain management, and we want to be a part of this by investigating how the data that are collected by using traceability technologies can be used in the best way possible to gain more consumer trust and loyalty. Our suggestion will be to use the data collected in their marketing activities to show the consumers exactly when, where, and how the food has been produced. To summarise our identified gap, this technology is new in the way that it is used today, which means that there is not much research done on this topic. We want to take previous knowledge and connect it with this new method to conclude the importance of blockchain traceability technology more concretely in the food industry.

1.4 Purpose

The purpose of this thesis is to find out the effect of blockchain traceability technology on the food industry's supply chain and to contribute valuable insights for companies and consumers. The study measures the attitude of consumers toward the information and buying behaviour offered today. This thesis will be written from a company point of view but with a consideration of consumer behaviour, in other words, to show companies the benefits of traceability when implementing it throughout the supply chain. The two illustrative case studies are there to represent both opportunities and challenges, which gives us two different perspectives on implementing traceability technologies and will help answer the research questions with the most nuanced answer possible.

1.5 Research Question

This paper will examine the following research questions:

RQ1. "What opportunities can companies in the food industry gain by implementing blockchain traceability technology along the supply chain?"

RQ2. "What challenges can companies in the food industry face if implementing blockchain traceability technology along the supply chain?"

These two research questions will help present the different opportunities and challenges a company can face if they choose to implement blockchain traceability technology solutions along the supply chain.

1.6 Definitions

Throughout the paper, we will refer to words such as transparency and traceability. This table has been compiled to clarify and make it easier for the reader to follow through the different chapters.

Concept:	**Definition:**
Blockchain	*" Is like a database, it is a way of storing records of value and transactions" (Bettín-Díaz et al., 2018).*
Consumer loyalty	*"A deeply held commitment to re-buy or re-patronize a preferred product/service consistently in the future, thereby causing repetitive same-brand or same-brand-set purchasing, despite situational influences and marketing efforts having the potential to cause switching behaviour" (Oliver, 1999)*
Supply chain management	*"Deliberate and organised coordination of traditional business functions and their associated strategies within a specific company, as well as across multiple businesses within the supply chain" (Choi, et al., 2020).*
Traceability	*"Traceability is the ability to identify and trace something or someone" (Thylstrup et al., 2022).*
Transparency	*"Defined as the free, uninhibited flow of information that is open to the scrutiny of others" (Ulrich, 2015).*

Table 1: Definitions of keywords

2.0 Frame of reference

The frame of reference will present the current literature on the topic and introduce the main concepts of traceability and areas that relate to it. The implementation process of traceability will be introduced as areas that can affect a company in the food industry.

This chapter presents an overview of the existing literature concerning the topic, followed by an examination of collected data that establishes the theoretical framework for the research. The objective of this chapter is to offer the necessary theoretical foundation on key concepts such as Blockchain, traceability, transparency, consumer loyalty, food retail, and supply chain management. The literature review will have a narrative literature review approach comprising four distinct stages, as outlined by Demiris et al. (2019). In the initial phase, an extensive search was conducted across multiple databases to locate scientific literature relevant to the subject matter. Multiple databases were searched to ensure the inclusion of the most relevant studies. The next step involved identifying keywords that were employed during the database searches to retrieve articles related to the topic. Furthermore, the authors conducted individual research on associated subjects using the keywords found in the indexed articles. The third step involved assessing the suitability of the identified articles for the study. Finally, the authors summarise and analyse the findings from the publications.

Method of screening of the literature:

Search parameters:	
Sources:	Academic articles, Academic books, Relevant reports
Databases:	Google Scholar, Scopus, Primo
Keywords:	Blockchain, traceability, transparency, consumer loyalty, challenges and opportunities, food retail, supply chain management.

Table 2: Screening of the literature

2.1 Literature review

2.1.1 Food industry

The food industry sector is one of the world's biggest, with a naturally growing demand due to the growing global population with unlimited demand and limited resources (Choi et al., 2020). The food industry is composed of many different actors from farm to fork, such as farmers, food processors, distributors, retailers, and consumers (Liu et al., 2020). The flow along the actors of the food industry's supply chain is illustrated in Figure 2.

Figure 2: Actors in the food industry

The farmer's main task is to cultivate crops and raise livestock to produce raw materials that will be used within the food industry. Food processors make use of these raw materials and transform them into finished food products, such as turning milk into dairy products like yogurt or cheese or making pasta with wheat and eggs. The activity carried out by the food processors depends on the food product that is being produced. Food processing activities also include materials processing, storage requirements solutions, preserving techniques, and packaging of finished products (Mor et al., 2022). Distributors are later transporting these goods to retailers such as grocery stores and other food providers. Retailers are the link to the customers. Retailers could sell producer products and own branded products and are together with other food producers brand creators of macerating commutation towards the customers (Liu et al., 2020). All these actors can be shaped on large and small scales, from a family-owned to a mass production farm or a farmers market, or a grocery store in a shopping mall (Booth & Coveney, 2015). The food industry is strongly regulated in terms of safety, animal care, and production process. These regulations are standardized in most developed countries in order to provide safety and quality for customers. For the farmers, there are strict rules of animal husbandry that need to be followed to get different kinds of certifications that indicate that the animals are being treated well (European Commission, n.d.). For consumers, certifications are guidelines for making consumer choices based on their values, and to get different food certifications, requirements must be met (Swedac, 2023).

2.1.2 Supply chain management in the food industry

Supply chain management can be defined as the deliberate and organized coordination of traditional business functions and their associated strategies within a specific company, as well as across multiple businesses within the supply chain. In other words, the process between actors flows from farm to fork (Min et al., 2019). The supply chain in the food industry is represented by its actors; farmers, food processors, distributors, retailers, and consumers. (Liu et al., 2020). In the food industry, the biggest challenge is the environmental impact, as food production accounts for over a quarter of global greenhouse gas emissions in 2022 (Ritchie, 2022). These greenhouse gas emissions come mainly from supply chain activities, as the production of our food mainly consists of methane and nitrous oxide from animal husbandry and crop cultivation, as well as carbon dioxide from the use of fossil fuels in agriculture and transportation (Franke et al., 2018). Therefore, the theory of sustainable development in the food industry's supply chain is relevant to understand the challenges that the food industry is facing and what areas of its supply chain can work for change. One of the most well-adopted definitions of sustainability was stated in 1987 by the United Nations Brundtland Commission (Brundtland & Khalid, 1987, p. 41) "Meeting the needs of the present without compromising the ability of future generations to meet their own needs." Sustainable supply chain management is the application of sustainable development practices into supply chain operations by implementing a long-term strategic and transparent approach to an organization's social, economic, and environmental goals. Social, economic, and environmental aspects of sustainability are referred to as the triple bottom line. As consumer awareness of social and environmental issues in the food sector has arisen, the food industry has been forced to adjust to new standards. One example of this is how food retailers coordinate with suppliers to share information regarding ingredients, growing conditions, food origins, and employee welfare to meet consumers' expectations (Choi, et al., 2020). The different actors in the food industry's supply chain can all have different interests in sharing their data, for example, to increase efficiency in resources but also to ensure food safety and quality. As a result of globalization, food supply chains have become more complex as they stretch over different global markets with an increase of actors along the supply chain. This has caused a challenge in the food industry, where it's become a more complicated process to track an end product's origins (Choi, et al., 2020).

2.1.3 Consumer behaviour

During the last couple of years, marketing has become more digital, and consumer behaviour has changed throughout the years (Vitsentzatou et al., 2022). Consumer behaviour is the connection between marketing and economics. It entails a comprehensive analysis of the psychological and behavioural actions undertaken by individuals as they engage in the process of searching for, evaluating, purchasing, and utilizing a diverse range of products or services (Cole, 2007). Consumer behaviour is also about the motivational forces that go into a purchase decision (Philips, 2021).

Since the beginning of the 21st century, consumers have been educated about the challenges of climate change and environmental impact. A more conscious consumption behaviour has been established behaviour consumers as a result. Consumers are demanding more transparency and want to understand a product's origin. As consumer demand constantly changes, so are the forces for change in consumer behaviour. The main driving force for change in consumer behaviour is technological development. The more interaction with new technology, the more open consumers become to adapting to the new technology and changing their attitude towards it (Szmigin & Piacentini, 2018).

2.1.4 Consumer loyalty

Consumer loyalty refers to the extent to which a customer is committed to purchasing products or services from a particular company or brand over a long period. It is an essential concept in marketing and is often seen as a critical driver of business success. A loyal consumer is more likely to purchase from a brand repeatedly. The consumer will also be more likely to recommend the brand or product to others. Several factors can contribute to consumer loyalty, including the quality of the products or services, the perceived value for money, the level of customer service, and the emotional connection that customers have with a brand (Oliver, 1999). Another factor that can affect brand loyalty is transparency. According to Eskildsen and Kristensen (2007), there is a "clear relationship between the perceived transparency and the perceived value." Meaning that the more transparent a company can be towards its customers, the more value will be perceived. Environmental awareness also has increased during the last couple of years. According to Lin et al. (2017), consumers are willing to pay more for products that are perceived to contribute to social responsibility. The fact that not all organizations are honest about their green marketing has led to a gap between attitudes toward sustainability and actual consumer behaviour. Sustainable products are often more expensive, requiring more

information to make a green decision (Meise et al., 2014). The results found by Lin et al. (2017) show that if a company wishes to enhance a consumer's loyalty and trust, it should invest more resources to improve its transparency.

2.1.5 Transparency

The word transparency correlates to the word clarity, which means to be clear or see-through. The word can be used with different associations, such as politics or business. The use of transparency in the business context that we will investigate is to increase trust and gain better customer relationships. On the other hand, a lack of transparency in a business lead to suspicions of illegal or unethical activity (KEYENCE America, 2023). Transparency in marketing means being open and honest about the products and services you offer your customers, giving insight into the supply chain, including their features, benefits, limitations, and pricing (Buell & Kalkanci, 2021). When providing consumers with accurate and complete information about products and services, they can make informed purchasing decisions. Marketing transparency is becoming increasingly important in today's world, where consumers have vast amounts of information at their disposal and are sceptical of marketing claims. Transparency helps businesses build trust with their customers and differentiate themselves from competitors who may use misleading or deceptive marketing techniques (Buell & Kalkanci, 2021). Marketing transparency includes providing clear and concise product descriptions, disclosing potential risks and side effects, using third-party testimonials or reviews to verify claims, and transparent pricing and refund policies. It also means talking openly about the company's values, social responsibilities, and ethical practices. Overall, marketing transparency leads to more loyal customers, more sales, and a better reputation for your business (Buell & Kalkanci, 2021).

2.1.5 Relation between consumer loyalty and Transparency

The relationship between consumers and businesses is influenced not only by the transparent behaviour of businesses but also by consumers' subjective assessments of how businesses behave in situations where behaviour is not transparent. Socially responsible companies are in a unique position. They not only ask consumers to trust that their products will be satisfactory or that returns, and complaints will be handled fairly, but they also encourage trust in certain communication and unobserved intentions to fulfil social responsibility (Kang & Hustvedt, 2014).

Transparency is the key to customer loyalty. When companies are transparent about their products, services, and business practices, customers are better informed and can make better decisions. Transparency creates trust and loyalty, as customers feel that a company seeks their best interests. On the other hand, if a company lacks transparency, customers may feel cheated or betrayed and lose trust and loyalty. For example, suppose a company does not show the ingredients or sources of its products. In that case, customers can feel uncertain about the safety and quality of their products, and loyalty may suffer. Therefore, transparency can be an essential part of customer loyalty. Companies that prioritize transparency and openness in their business are more likely to build strong, trusting relationships with their customers, leading to customer retention and long-term business success (UNECE, n.d.).

2.1.6 Traceability

This thesis focuses on traceability within the supply chain and the importance of being able to trace back information in the supply chain. Traceability is interconnected to transparency and is about the capability to trace something, when and where the product was produced, and by whom. The combination of the two is necessary across global supply chains to increase and realize the full potential of the circular economy, which today has many obstacles to overcome (UNECE, n.d.).

Traceability has different meanings in different contexts. For example, in the food industry, traceability refers to tracking the movement along the food supply chain from origin to the point of consumption, including information on the raw material origin, processing, packaging, and distribution. From the consumer perspective, transparency is key because consumers want to know that the product aligns with their values as well as their worldview. In the twenty-first century, consumers' greatest concerns include health, community, the environment, and social concern. This has led to increased interest in food products marked with, for example, Fair Trade, organic, or locally grown labels (Choi, et al., 2020).

Traceability in software development refers to the ability to track relationships between various software artefacts, such as requirements, test cases, and code. This information is important to show that the software system meets the desired quality attributes and compliance standards. This information is critical to ensuring food safety, managing product recalls, and preventing food fraud (Choi, et al., 2020). In general, traceability is a key concept to ensure safety, transparency, and quality in various fields.

The relationship between traceability and transparency correlates so that traceability improves transparency. A transparent supply chain allows companies to foster trust among stakeholders such as customers, suppliers, and investors. Traceability allows companies to track the movement of products and materials through the supply chain and share this information with stakeholders. This helps build trust in the supply chain and the products being manufactured (Garcia-Torres et al., 2021). Traceability and transparency are interrelated concepts that help companies build trust with their stakeholders. Implementing a traceability system allows companies to provide transparent information about their supply chain and helps build trust between stakeholders.

When talking about traceability, there are a few technologies that can be used to improve traceability along the supply chain. Blockchain is only one traceability technology that can be used to get full access to authentic information on a product's journey from producer to retailer (Casino et al., 2021).

This information could then be presented directly to the consumers. This is an important part of the food industry and the accessibility to information about the food you eat. Previous or more traditional food tracking systems mostly kept information during an outbreak. The consistent and united nature of the data contained in the blockchain allows consumers and other interested parties to trace the origin and movement of the product themselves (Lin et al., 2020). This is possible due to a unique identification tag from when the animal is still on the farm. Later as the animal goes through the different processes, everything is logged by the farmers themselves. This technology can also record information such as the temperature in the truck that carried out the transport of the product. The information gathered along the entire supply chain can then be available through a Quick Response (QR) code on the packages at the retailer or even on restaurant menus. To use the QR codes, you simply use your mobile device to get full access to all the information from farm to consumer (Biele, 2019). The reason for implementing traceability technology such as blockchain is that it creates accessibility to a lot of information for consumers. It can also bring other valuable features, such as information about the farm, messages from the farmer, and other interesting information regarding safety or sustainability (Bandoim, 2019). This type of traceability technology, such as blockchain, has already been implemented by some retailers and producers, such as the French retailer Carrefour (Carrefour Annual financial report, 2022).

2.1.7 Blockchain traceability technology

Blockchain is a technology that has been used since 2008. It is a peer-to-peer decentralised system, meaning that the computer system is dependent and linked together. Blockchain technology is a chain of data that are linked together that are strongly encrypted to the design of the blockchain technology. This security aspect is the essential part that has made blockchain successful in many areas, such as fintech and cryptocurrencies. The main concept of blockchain is that any data in the network can't be tampered with since each block of data depends on previous data along the blockchain. The data along the block are moving quickly and accurately thanks to smart contracts. Smart contracts are a core part of the blockchain that allows contracts and agreements outside the blockchain, bringing in new data automatically (Centobelli et al., 2021).

Blockchain has recently become more integrated into many aspects of global supply chains within many industries, such as the food industry, thanks to the quick and accurate amount of data in blockchain processes of optimizing raw materials, supply chain management, waste management, circularity, recycling, traceability, and status of components for production (Mor et al., 2022).

In traceability aspects, blockchains can provide trustworthy and accurate data along a company's whole supply chain. Many companies are sharing their gathered data with business partners like suppliers, distributors, etc. This creates a more transparent supply chain, leading to greater trust (Centobelli et al., 2021).

According to Lemos et al. (2022), blockchain technology can help fight widespread fraud, create a healthier market space for all stakeholders, and strengthen the relationship between brands and consumers. Blockchain is unquestionably beneficial for marketing activities because of its high-quality and transparent data. A technology like this will solve the security flaws that exist in the marketing sector, generating more security, accuracy, and data privacy (Bettín-Díaz et al., 2018).

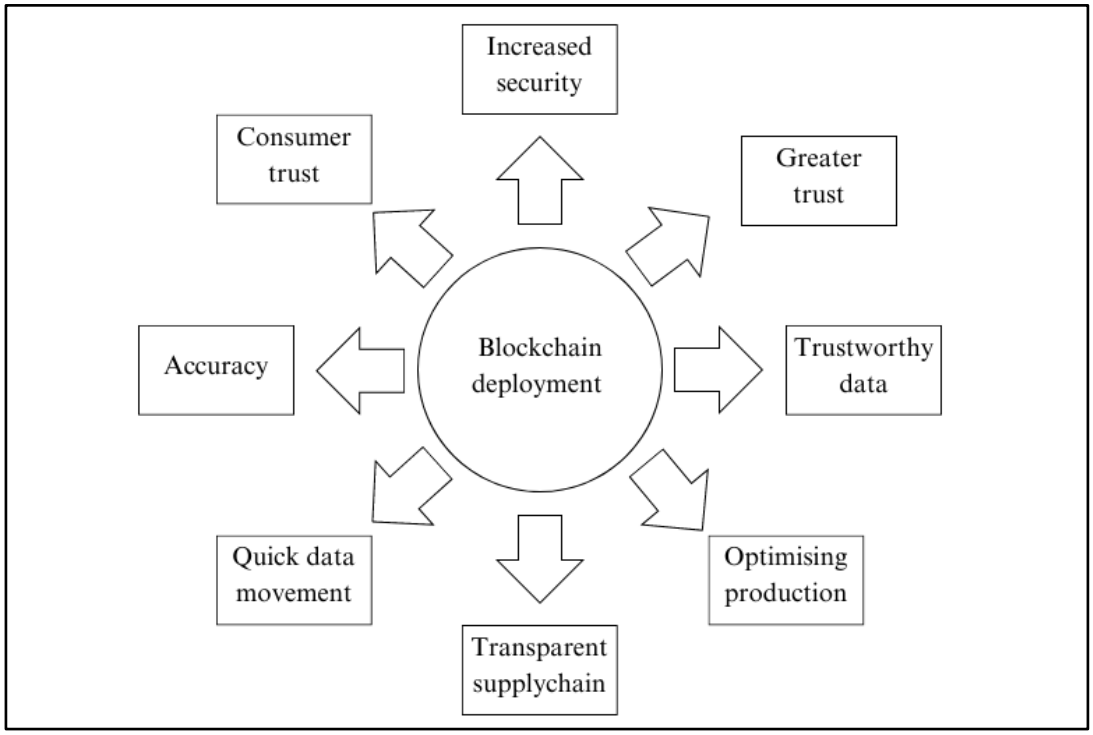

Figure 3: Blockchain deployment (Reproduced from Madhani, 2022)

The figure above explains the benefits and opportunities that can be expected if using blockchain deployment (Figure 3). Possible benefits are increased data security, consumer trust, increased transparency, greater customer privacy, etc. (Madhani, 2022).

2.1.8 Implementation of blockchain traceability technology

As described in the section above, blockchain is typically a secure distributed ledger that maintains an immutable record of transactions that requires consensus on all changes. It aims to lay the foundation for efficient and transparent management of sustainable supply chains, enabling the creation of smart networks for information mobility. As a result, many companies have already adopted or are considering adopting blockchain technology to improve their business operations along the supply chain (Zhang, 2022). The implementation of traceability into a company's operations affects a company's organization in many dimensions. It will affect internal and external operations due to the integration of the whole value chain. When a company starts the process of implementing traceability, it is essential to identify what parts of the supply chain that wants to be traced. Implementing traceability is a costly investment. Therefore, it's important to understand the benefit of implementing traceability (Kraisintu & Zhang, 2011). In marketing, implementing traceability can be a valuable tool for businesses in five main areas: Accuracy, Transparency, sustainability, quality assurance, and marketing

claims. By implementing traceability, companies can get more precise and accurate traceable data thanks to smart contracts and encryption (Madhani, 2022).

According to Madhani (2022), the use of blockchain in marketing positively impacts the effectiveness of marketing strategies and, ultimately, business performance by improving the consumer value proposition, increasing sales, reducing costs, and increasing profitability. The total value created in marketing with the help of blockchain applications enables companies to improve the efficiency and effectiveness of their operations, better serve their customers, and thereby create a competitive advantage. This is also confirmed in the peer-reviewed academic article by Tan et al. (2022), where it is claimed that blockchain aims to improve efficiency and transparency. According to the founder of food traceability technology company OpenSC Markus Mutz (2020), blockchain should be implemented where it adds new value to operations. He also mentions the importance of changing consumer behaviour because they get new information and how the information that is being shared differs from product to product (Mutz, 2020).

Blockchain's advantage in business scenarios where no single entity has control is its ability to address issues of transparency and accountability between individuals and institutions, even if their interests are not fully aligned. By facilitating real-time updates of vital information for all parties, blockchain eliminates the requirement for time-consuming procedures with each party's internal records (Casey, 2017). It will add higher levels of security, traceability, transparency, safety, and efficiency (Kshetri, 2018; Aste et al., 2017). This will affect consumer loyalty and trust due to its traceability along the supply chain (Biswas et al., 2017).

Despite all the benefits of blockchain deployment, some obstacles remain to this decentralised network. Firstly, because it's almost military-grade safe and fast, it's very energy-consuming which in itself is a primary environmental concern (Maitra et al., 2021). Secondly, during the implementation of a traceability system, the main concerns for the actors in the supply chain are the cost. The implementation itself is expensive even if one of the benefits later is to reduce the costs of third parties (Lin et al., 2022). Another problem in the blockchain is the lack of expertise in the area and a lack of people specialising in blockchain (Eliaçık, 2022). In general, many of blockchain's most significant stumbling blocks reflect the growing pains that plague any new technology.

2.1.8.1 Transparency and trust

Implementing traceability technology into companies' operations will affect companies' ability to work transparently along their whole supply chain and enable them to give better and more detailed insight into operations along all aspects of the supply chain (Tan et al., 2022). From a marketing perspective, implementing blockchain-based traceability can ensure that data have not been tampered with giving a company the ability to do marketing claims such as origins of raw materials, and transportations rout and giving better and more transparent insight into one's operations since the claims can be backed up with traceable data. These aspects of traceability have the ability to increase the loyalty and trust of the end consumer (Madhani, 2022).

2.1.8.2 Marketing claims

As a result of increased transparency and trust, a company can back up claims in their marketing communication and reduce the risk of backlash accused of greenwashing. Greenwashing is defined as the act of misleading consumers about their environmental practices. Companies that face greenwashing accusations risk harming their brand and reputation (Delmas & Burbano, 2011). As consumers demand more insight to make a purchase decision based on their values, providing accurate, trustworthy, and traceable information about the product's production chain becomes more crucial and could even justify a higher price tag for consumer goods (McKinsey & Company, 2023).

An example of the implementation of traceability technology that has been used for marketing claims and communication is the French grocery store company Carrefour which has, with the help of blockchain technology, labelled its own branded products, such as fruits and dairy products, with a QR code that contains detailed information about the country of origin and transportation routes. Carrefour made this feasible by cooperating with IBM Food Trust Platform, a blockchain-based traceability program (Carrefour annual financial report, 2022). This allows consumers to make a more sustainable cautious choice and increases Carrefour's consumer loyalty and transparency. Giving consumers easily accessible and clear insight into a company's operations can also be a driving force for increasing brand equity, as the consumer is interacting and gaining better insight into a company's operations, giving a company a stronger quality perception (Madhani, 2022).

3.0 Methodology

This part will illustrate the methodology and methods employed in this research. The methodology outlines the research philosophy, approach, and design.

This study will be qualitative, which is a research method that seeks to explore and understand complex social phenomena through the collection and analysis of non-numerical data such as text, images, and observations (Collis & Hussey, 2014).

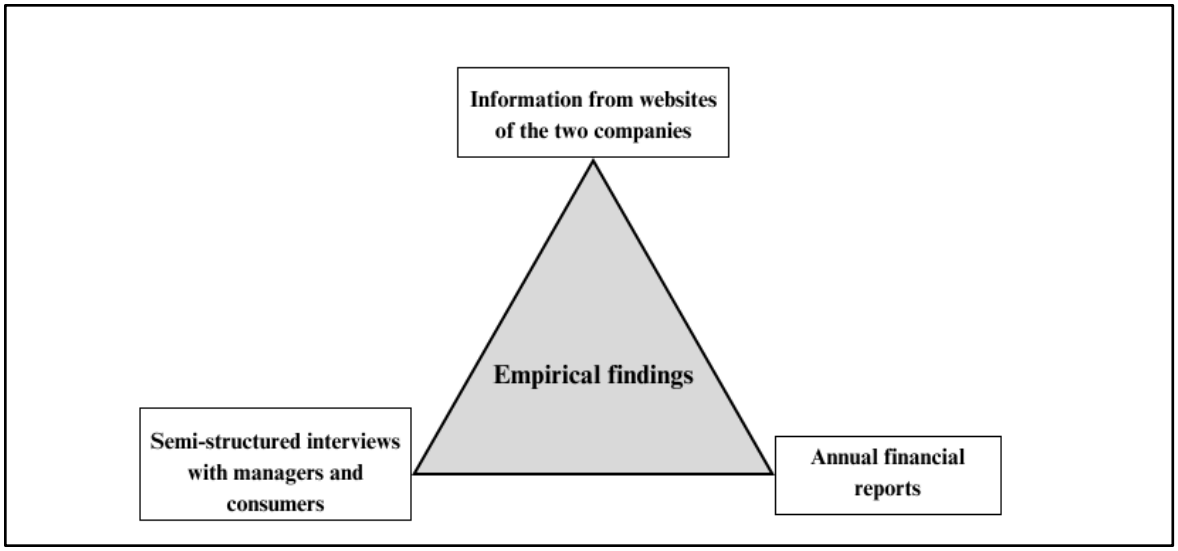

Figure 4: Triangulation of Data

This study will use triangulation in data collection as a research method that increases the validity and reliability of observations by gathering information from multiple sources or using multiple methods to study a phenomenon (Figure 4). This involves cross-checking or validating data from different sources or methods to ensure consistency, reliability, and accuracy of results (Carter et al., 2014). The first case study will be studied by website information, annual financial reports, and semi-structured interviews with managers working on Arla in appropriate positions. The second case study on Carrefour will be slightly different. It will be studied through website information, annual financial reports, and semi-structured interviews with company consumers.

3.1 Data collection method

The chosen data collection method is an illustrative case study method. Illustrative case studies are a qualitative research method that explores and analyses a single case or a small number of cases in detail in order to gain insights, formulate hypotheses, or explain certain phenomena or concepts (Collis & Hussey, 2014). It is a descriptive investigation that provides rich and detailed information about a specific case. Multiple sources are often used to research and understand a research topic thoroughly. Some limitations of using illustrative case studies are the potential for subjectivity and bias to affect the findings (Collis & Hussey, 2014). Researchers and authors often rely on their interpretations and judgments when analysing data, which can lead to skewed results. It's crucial to remain objective and consider multiple perspectives when conducting a case study to ensure that the findings are as accurate and unbiased as possible (Collis & Hussey, 2014). This study will be built upon two case studies to be able to get all perspectives and to answer the research question in a nuanced way. The two cases will show two key points to show the complexity of traceability. The illustrative case study is divided into steps such as case selection, data collection, data analysis, and interpretation, which is how the methodology section will be divided.

3.2 Case selection

Arla and Carrefour are two big companies in the food industry that are relevant to the research topic, although they differ slightly. One of the companies sees the opportunities, and the other sees more challenges that fit the research questions well and covers both perspectives. The cases were also chosen on their accessibility of information, Arla had disposable managers with valuable insights, and Carrefour provided opportunities in their financial report together with other accessible documents from their website.

3.3 Data collection

The collected information is from various sources such as interviews, documents, annual financial reports, and website information to gather comprehensive and detailed information about the two cases. Multiple data sources are used to ensure data triangulation and improve the accuracy of results. First, the authors decided on the paper's aim to be able to do appropriate research and collect a good scope of data. Later when collecting the data, the literature review is conducted, and a research question is formulated. Then sampling was done to choose our

most fitting candidates for interviews (Figure 5). Since our data analysis method is thematic, we transcribed the interviews before thematising them. After the thematization is, the data analysed before answering our research question.

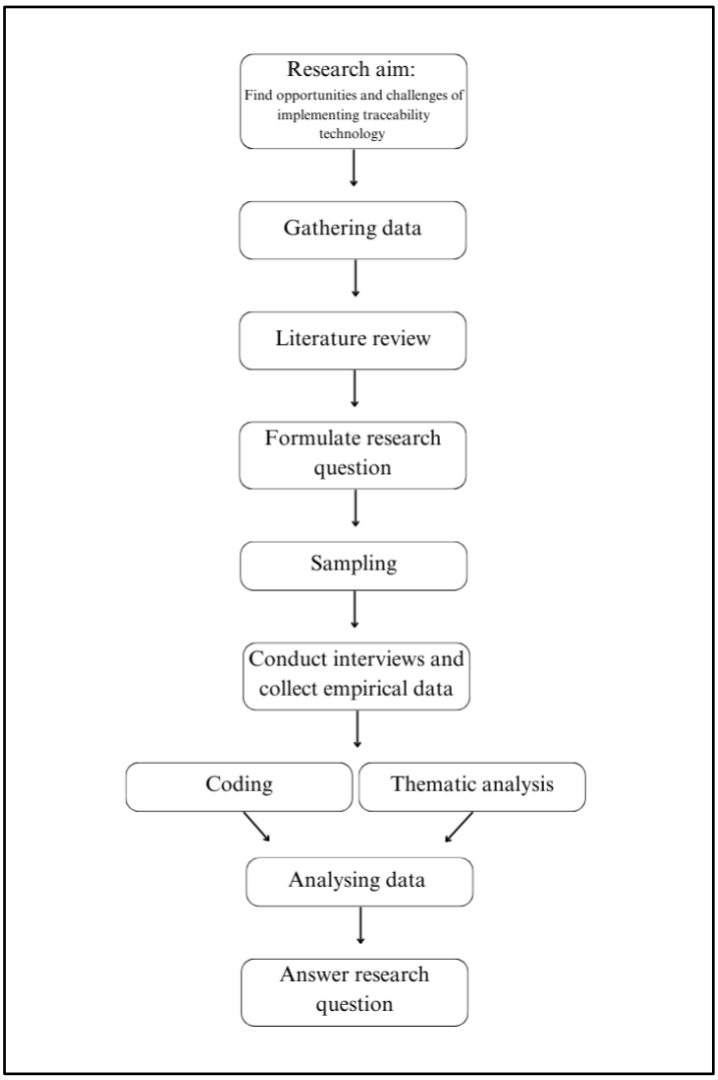

Figure 5: Process

3.4 Data Analysis

This study will use a thematic analysis method with an inductive approach to analyse the data presented in the empirical findings, meaning that the themes are not expected before analysing the data (Collis & Hussey, 2014). A thematic analysis method closely analyses the data by finding common themes and topics in the text. The text that has been thematised in this study is interview transcriptions, and this has been done with a six-step method by Braun and Clark (2006), which are two professors in psychology who have been awarded for their books in successful qualitative research (Braun & Clark, 2023). The six steps involve familiarisation, coding, generating themes, reviewing themes, defining themes and lastly, writing up.

The first step is about getting to know the data you have; this has been done by transcribing the interviews and reading through texts while taking some notes. The second step is the coding; here, the essential parts will be highlighted in different colours depending on what corresponding subject it fits too; new codes are also added as we go through the text. The third step is generating the themes and finding and connecting patterns among the codes. The next step is the fourth involving reviewing the themes just created. This can involve going back and checking up on mistakes or changing them around. The fifth step is defining the themes; this is about giving them names to understand better what they are about. The sixth and final step is to write up, adding our thematised information to the empirical findings (Caulfield, J., 2022).
The research philosophy that will be used in this qualitative study is interpretivism. According to Collis and Hussey (2014), interpretivism is a research paradigm focusing on understanding human behaviour and the social world by interpreting meanings and subjective experiences. In interpretivism, researchers acknowledge that people have unique experiences and interpretations of the world around them and that these interpretations shape their actions and behaviour. One key aspect of interpretivism is the concept of reflexivity, which involves reflecting on the researcher's biases, assumptions, and experiences that may influence the research process and findings. This can be particularly important in qualitative research, as the researcher is often directly involved in collecting and analysing data.
Overall, interpretivism offers a flexible and nuanced approach to qualitative research that can help researchers better understand social phenomena and human behaviour. By prioritising subjective experiences and interpretations, interpretivism can offer insights only sometimes captured by more traditional, positivist research methods (Collis & Hussey, 2014).

3.6 Exploration of consumer behaviour

Surveys are a standard research method in social science research, often used to quickly collect data from many participants. Surveys can gather information on various topics, from attitudes and beliefs to behaviours and preferences. This work explores using surveys as a suitable research method to study consumer behaviour.
To collect data on consumer behaviour, we surveyed 80 participants via a Google form. The survey consisted of multiple-choice, ranking, and open-ended questions. Questions covered various topics, including shopping habits, brand loyalty, and decision-making.

We decided to explore consumer buying behaviour to back up our questions during our interviews with the different companies and consumers. The survey results highlight the importance of transparency and traceability in consumer behaviour, which has important implications for businesses looking to attract and retain customers. The results also showed that almost half of the participants believed the information available today on any product regarding sustainability, country of origin, labour conditions etc., is insufficient. So far, we have also gained insight into what type of companies people refer to as sustainable and why they believe that. The survey has also concluded that the participants are willing to pay more for more information about the product. The survey is not used as empirical findings because of the need for more trustworthiness in sampling. However, we still use the data collected as previous knowledge before going into our interviews, where they could confirm or deny our findings.

Limitations when conducting these types of surveys is the fact that people are willing to say on a form that they are willing to pay more, for example, but in real life, they might not be willing to do so.

3.7 Interviews

This study will include semi-structured interviews with participants to collect qualitative data on traceability across the supply chain. The interviews aim to gain insight into how companies are currently using traceability, areas for improvement, goals, and reasons why or not to use traceability in their marketing strategy to increase customer loyalty. Interviews will be recorded and transcribed, and data will be analysed using a thematic approach. The interviews will last about an hour.

Interviews are conducted with two managers at Arla Food, a Danish-Swedish dairy company leading in Scandinavia and the United Kingdom. Other interviews are also conducted with consumers of Carrefour that can have valuable insight into the opportunities and challenges with transparency implementation for the food industry.

We have chosen to pilot all of our interviews before conducting them to ensure that the questions make sense and have a preferable flow. This gives us insight into whether we want to change the structure beforehand and if the interview is around the appropriate amount of time.

Sector	Organisation	Interviewee	Date	Duration
Agriculture producer	Arla Sweden	Sustainable brand manager	3/4	40 min
Agriculture producer	Arla Sweden	Digital products manager	19/4	55 min
Retailer	Carrefour	Consumer 1	27/4	16 min
Retailer	Carrefour	Consumer 2	27/4	12 min
Retailer	Carrefour	Consumer 3	27/4	19 min
Retailer	Carrefour	Consumer 4	11/5	14 min

Table 3: Interview schedule

3.8 Interview selection

This section will show the process used to select interview participants, justify the selection criteria used, and explain how the selected participants are relevant to the research question. Firstly, Arla was selected as a case because it fits very well with our research, and we had already researched the topic. Arla is working with traceability in their campaigns, for example, their campaign called data-driven agriculture (Arla, 2023).

The two interviews with Arla managers were selected based on their area of responsibility; they were chosen because of their ability to answer our questions regarding traceability, transparency, and consumer loyalty. Since not only one person could answer all our questions, but it has also been divided into two different interviews with two different topics. One interview was with the sustainable brand manager of Arla, in which we asked questions about marketing and their strategy to advertise more transparently with the help of their existing data. The second interview was conducted with their digital products manager because we wanted to ask questions about the technology itself. The manager could help us answer questions about blockchain, traceability and data collection. We chose not to interview a supply chain manager because this information about the company was already accessible on their website.

Carrefour was a given example when choosing the two case studies because of their work with blockchain technology throughout the supply chain. When writing about Carrefour's work, we could find a large amount of data just by looking through their sustainability and financial

rapport, meaning that we do not have to interview anyone from within the company. This made us reach out to Carrefour consumers in France who have been customers at Carrefour and are aware of their QR-code scanning technology. They did not have to have used it or been using it frequently; the only criteria we had was that the person must have chosen to use it or not to use it. We still lack the perspective of consumers who are using this technology daily.

3.9 Ethical consideration

Ethical aspects of this study were carefully considered to ensure a professional approach during the research. Respect for the privacy and confidentiality of the interviewees became fundamental ethical principles in this qualitative study. Ethical practices such as informed consent, privacy, confidentiality, anonymity, and voluntary participation have been introduced and adapted to address these issues (Collis & Hussey, 2014).

Both company and customer representatives. To maintain the ethical importance of anonymity and confidentiality, the authors took steps to protect the privacy of the individuals, groups or organisations participating in the study. Maintaining the anonymity of participants was crucial to encourage honest responses and protecting both individuals and their organisations (Bell & Bryman, 2015). When approaching the interview participants, the research objectives and the respondents' roles were clearly stated, ensuring the research process's transparency and honesty (Collis & Hussey, 2014). In addition, the researchers explained that only the authors could access the recorded data, thus ensuring the confidentiality of the collected data.

Additionally, participants received a transparency and understanding document containing the study context and the interview questions. To confirm voluntary participation and transparency, participants were sent an interview consent form emphasising the importance of their consent, as seen in Appendix 1 (Bell & Bryman, 2015).

4.0 Empirical findings

In this section of the thesis, empirical findings from two case studies with interviews from a food producer and consumers are going to be presented.

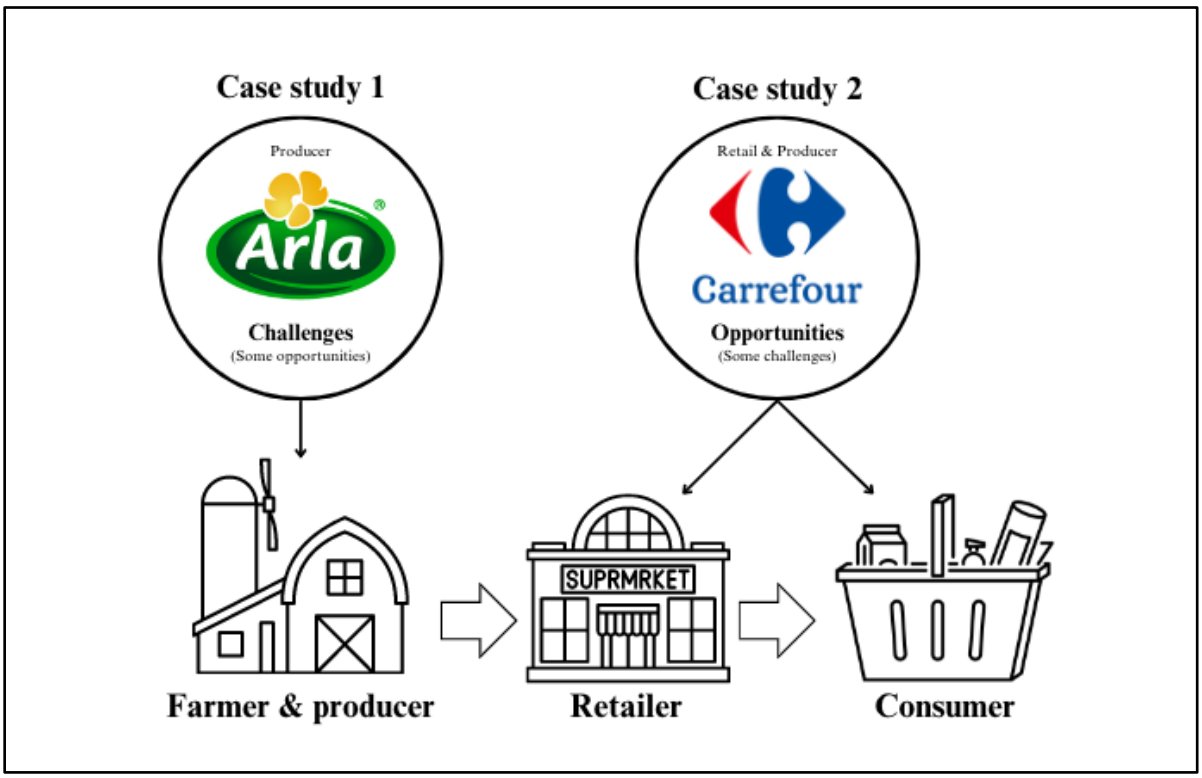

Figure 6: Illustrative case study

The figure above shows how the empirical facts will be presented (Figure 6). Case study 1 will investigate Arla's work with new technologies such as blockchain traceability; they have not yet implemented anything like this and have seen many challenges. In case study 2, there will be a deeper understanding of Carrefour's work. They have already implemented blockchain traceability technologies in their work and are very opportunistic with their work with blockchain traceability solutions. This will give a deeper understanding of the opportunities and challenges of implementing blockchain traceability technology in the food industry. By doing this, we will have all aspects of the supply chain, from farmers and producers to retailers and consumers, to get the most accurate understanding.

4.1 Case Study 1 (Arla)

This section of the thesis will present the empirical findings from Arla's interviews. The information will be presented regarding the thematic we have found when transcribing and thematising the interviews. It ended up with themes such as honesty, trust, blockchain technology and consumer behaviour which will be implemented into the different parts when presenting the empirical findings as a summary of what has been found. The figure below shows the thematization from interviews with the two Arla managers. The codes are identified as keywords from the interviews and later collected into sub-themes. Each section will describe the findings from the thematization (Figure 7).

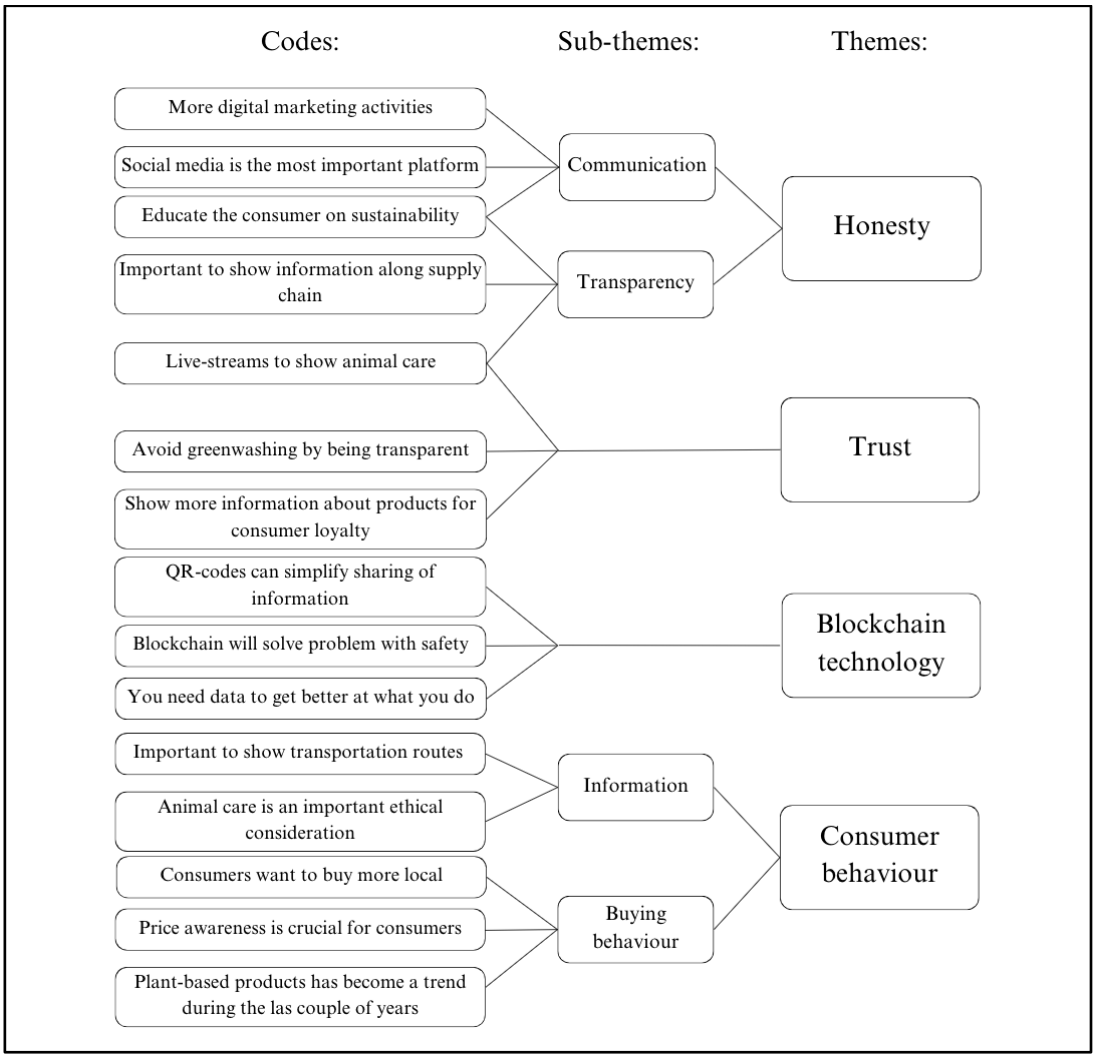

Figure 7: Thematisation of Arla managers

Arla Food is a Danish-Swedish multinational farmer cooperative operating in the dairy industry. The cooperative consists of the farmers themself and was founded in 1881 in Sweden and has since grown to become one of the world's largest dairy companies in 2023. Arla operates in more than 100 countries and has over 19,000 employees. Arla produces a wide range of dairy product categories, including milk, butter, cheese, yoghurt, and other dairy-based products sold to food retailers (Arla, 2023). Arla's supply chain operations consist of farmers, distribution, production, customers, and consumers. The farmers contain the milk from the cows. After the milk has been collected and stored, the distribution transport collects milk for production. Arla's production process covers materials processing, storage solutions, preserving techniques and packaging of finished products that are later transported to Arla's costumes. When talking about the costumes of Arla, it is mainly food retailers. The end consumer of Arla's products purchases them from food retailers (Arla annual financial and suitability report, 2022). The company aims to commit to sustainable and responsible dairy farming practices, and it works closely with its farmer-owners to ensure the highest quality milk. As a producer, processor and transporter of milk, Arla can track the climate footprint of its products throughout the supply chain from cow to consumer (Arla Food, 2022).

Arla is currently not utilising any blockchain-based traceability technology. Instead, they work with data collected from farmers. Data calculates environmental impact, sustainability work and supply chain efficiency. Arla is working on their reporting of environmental impact with third-party food industry environmental experts (Arla CSR report, 2021). Arla’s products are sold under brands such as Arla, Castello, Lurpak, and Puck, among others. The company strongly focuses on innovation and regularly introduces new products and variants to meet changing consumer demands. Arla is well known for their marketing communication strategy, including creative ways to reach and engage customers through packaging, commercials, and digital means (Arla annual Financial and suitability report, 2022). The next section of this case study will be the results from two interviews with Arla managers.

4.1.1 Marketing

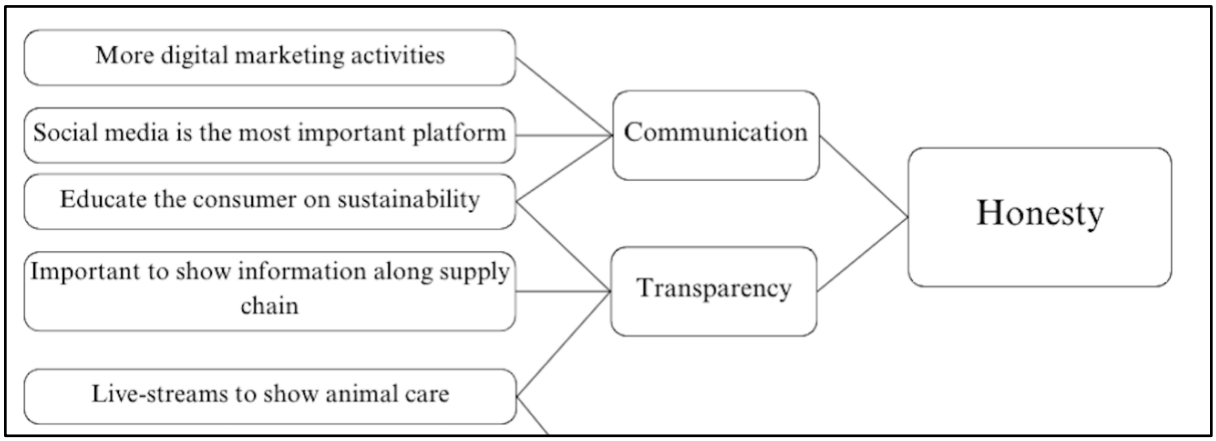

Figure 8: Thematisation honesty

The marketing part is researching what the market looks like today through the eyes of enterprises and marketing managers. The figure above shows some of the most important findings about communication and transparency (Figure 8). The key theme is honesty which is a vital part of their marketing strategy, and the other codes will be explained later in this chapter. To begin with, the first interview concluded that marketing has switched from more traditional to more digital.

"If you look broadly speaking, marketing has become more and more digital" (Interview 1).

It was asked if QR codes would be a fitting solution for marketing like Carrefour has done. Arla then explained that they had researched this and some experiments with solutions like this in Finland with their new products.

"We have, of course, discussed this a bit and looked at it. And we have done some tests, a little bit, especially when we talk about marketing. Has such a test been done? In Finland the starting point was really this idea, then you end up not knowing the blockchain. And that project. It's all about that idea because I'm holding a milk carton in my hand. How has it travelled and where it comes from? How did the animal feel this day? Yes, so you get everything that is interesting. Why it was also done in Finland is from a marketing perspective. So, in Finland, the main brand is Valio, as Arla is as usual in Sweden. You are a newcomer, so, of course, you try to do something new to show that you are at the forefront and so on" (Interview 2).

According to the digital products manager, the results from this were not as exciting, they got some boost in the beginning, but eventually, it started to decrease because, according to the manager, you will only scan the code once.

"It attracts some attention, but never mind that people are interested every time, right? So it looks like a cool thing you check up to 1 time (Interview 2).

The manager believes it is better to have control authorities to manage rules about the product's appearance. We would have a reliable source and not have to prove everything by being transparent or having traceability.

"Transparency is one thing, but this is another. Then the most important thing is that there are control authorities, bodies that ensure that this food is produced in a… way that we agree with. And that there is this type of regulation instead of all people should become these control persons because it is possible. Not because individuals are not able to handle that information, I would say" (Interview 2).

4.1.2 Transparency

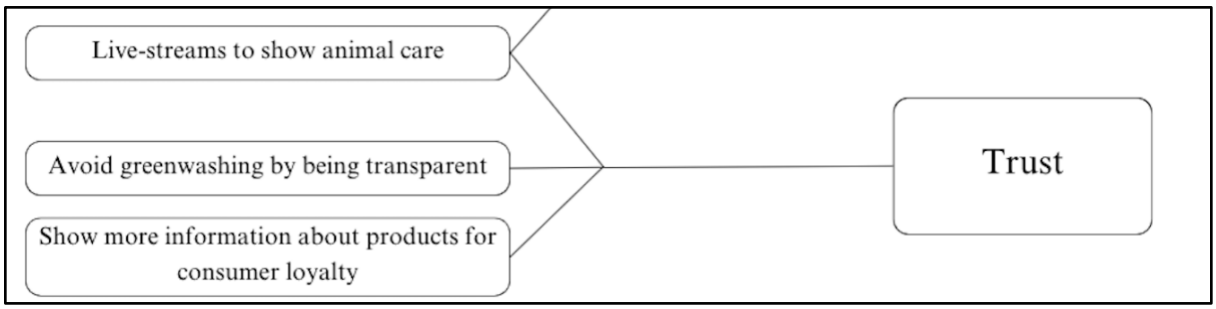

Figure 9: Thematisation trust

Firstly, it has been identified that transparency is essential for Arla's consumers (Figure 9). For transparency, we wanted to know if they experienced themselves as a transparent company and how they are working with transparency. Here is their central theme: trust. This section will explain how Arla is working with transparency to gain trust throughout the supply chain and from consumers.

"If you ask consumers, transparency is something we have seen that they have answered that they really want" (Interview 2).

Arla is very aware of their transparency, which they have put much thought into. Their sustainable brand manager explained that they have nothing they do not want to share, but it is more of a question about what the consumer wants to know.

"I should say that there is nothing about transparency that we want to hide or not keep. But then it's like how much information does the ordinary consumer or person really want, so we're happy to be like this, but we can share this report of like 100 pages, but there are only a few people who want to go in and read this" (Interview 1).

The second manager at Arla agreed that the consumers are willing to take in only a maximum amount of information.

"When it's very complex, you can only highlight 3 different facts, because that's the only thing consumers can absorb, and then you still can't tell them something that is very complex "(Interview 2).

The manager continues…

"As soon as you get into any details, most people get a headache, and it is not really possible to answer it properly and no one can really answer it either" (Interview 2).

When we asked the digital products manager about blockchain, he strongly opposed it. The manager also tells us that IT is an environmental issue; if they implement blockchain, they will worsen it. The manager also concludes that technology is only sometimes a solution and something good.

"I think my personal opinion is that you create a data hell with blockchain. So somewhere, a limit. How much should we thus? Because IT is also a problem, IT is also an environmental problem. It is a huge problem that people sit on TikTok for 2 hours a day. People don't understand that. I work with computer technology and such, but I don't always see it as a salvation, a solution to everything as soon as something new comes along. Some people think that as soon as you hear something new about coal, it's a solution to everything "(Interview 2).

While seeing all of these challenges, the manager wants to let us know that it is not only harmful with data. You can use data to be better and to evolve.

"You need data to be able to get better at what you do. This, I believe in. I personally believe a lot in this" (Interview 2).

4.1.3 Traceability

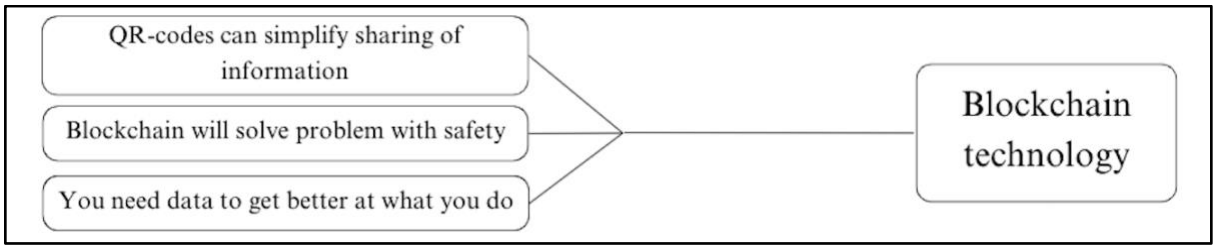

Figure 10: Thematization blockchain technology

When asking about traceability to Arla, it was evident that everything was well documented and that they knew precisely when and where the products were produced and their route. This makes it easier for them to trace if something has gone wrong along the supply chain. This section will also present the manager's attitude towards blockchain traceability technology solutions and what opportunities and challenges they see if implementing it (Figure 10). Firstly, questions about how they work with traceability were asked.

"The traceability is very well documented. We know exactly which farm and when the milk was collected. It is tested which truck is driving and back and which dairy and all products are also labelled exactly like this and where so that if there is something with any product, we can go back and troubleshoot what could go wrong" (Interview 1).

Questions about if Arla will use QR codes in the future were asked so the consumers can scan the products to get all the information they want. They answered that they see this happening in the future because of its easy usability.

"Yes, I think it will happen in the future but I there is such a big global project with just about QR code and transparency then exactly how detailed the information will be I do not know but yes it is because yes like you have our products and the package and everyone has the mobile phone in the other hand so it's like a perfect way of doing so" (Interview 1).

According to Arla, the challenge with this is that some people do not trust the claims, which makes Arla concerned about how safe the information they communicate to the consumers is.

"But if we do something and how we are going to tell people about this fantastic initiative we are doing, it is always like that. People who report us and so on, and we're also like this: if we're going to do something, we really have to Just have two hundred percent certainty and security in what we do and braces and belts and so on, and then such initiatives can also perhaps make it a little difficult to say yes, but what if this milk really did not come from that farm one hundred and ten percent of the time and then we would show some consumer the error of their ways and then someone would be like that and that can be a little limiting" (Interview 1).

The second manager also agrees with this and highlights the same challenges as the previous interviewee. Arla has chosen to keep their data more private because it is hard to show data without it backfiring.

"We have a lot of figures and data. We certainly have much more data on everything than most people do. But how should we present it like that? So, it's clear that we have eyes on us because people have eyes on everyone very much so as soon as we say anything at all, it kicks off immediately. So, we also have to take care of it, so we have this trade-off if we say something, and it backfires even if you have a purpose. Yes, that's what happens. It becomes difficult, so that's why it's easy to end up, but we have a lot of data" (Interview 2).

4.1.4 Consumer behaviour

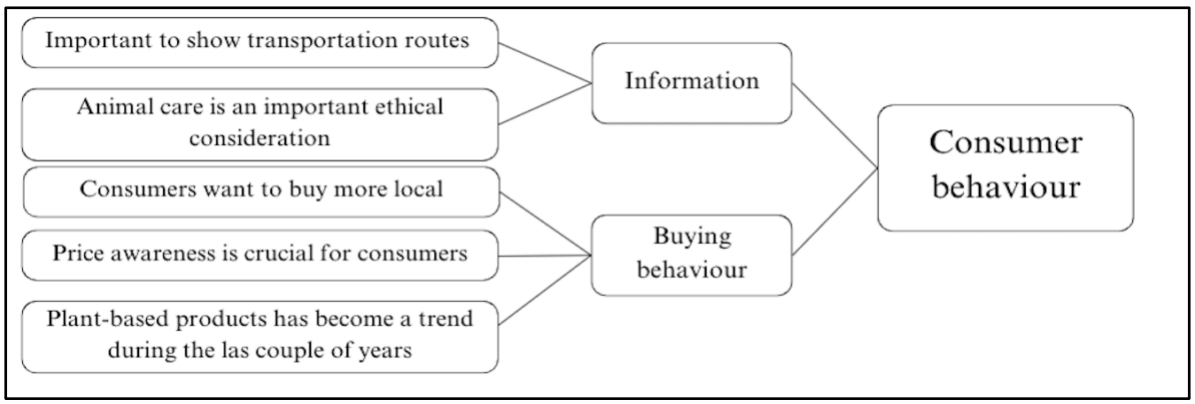

Figure 11: Thematization consumer behaviour

In the consumer behaviour segment, it was asked in the interviews what perceptions the different companies have on their consumers and if they meet the demands that the consumers have. As the figure above shows, transportation routes, animal care, local, price awareness, and plant-based are some of the most important parts of consumer buying behaviour (Figure 11). Firstly, the Arla managers concluded that almost 15-20% were uninterested in climate and did not want any additional information about the products because they did not care.

"I would say that there are 15, 20 % or so who are really perhaps completely uninterested in climate. And there are a few climate deniers out there" (Interview 1).

Secondly, they concluded that some people on the other end are informed about every decision and would love to have as much information as possible.

"Well, that's one end and then we have those in other subjects who are definitely informed about every choice they make" (Interview 1).

Lastly, Arla tells us that many people need more knowledge or energy to be aware, even if the amount of information increases. They might hear and trust something because they lack the energy to get into it.

"But of course, I want to buy something sustainable, and it should feel good. But you don't really have the energy to get into it, but you pick an argument here and an argument there, so I wouldn't be able to say that we've seen a huge increase in knowledge, but on the other hand, there's a much greater focus on media and many suppliers talk a lot about sustainability and there are sustainability certificates and so on" (Interview 1).

They were asked what they believe is the most essential information the consumers might want. Arla answered that animal care is the most important thing to know when buying their products, but this correlates to the fact that something is local or Swedish.

"It always peaks for the consumer when it comes to sustainability that the animals are doing well and good animal care. If we ask the consumer what's important, that's the top thing. But

then I also think this is about Swedish. It's very important and we see local as important" (Interview 1).

The digital products manager agrees and says people only care if the milk is local or Swedish; that is enough for them.

"We've done that and that's what people demand. It goes in waves. People want the milk to be local, that is. Sometimes it's the echo, but it has to be local. Been a trend. It's like this. People have an idea of what is local and good" (Interview 2).

4.2 Case Study 2 (Carrefour)

To better understand how blockchain-based traceability technology can be implemented in a food industry's supply chain, a closer look at a successful implementation will explain what challenges and opportunities come with it. This case study is carried out with data mainly from Annual financial reports. Carrefour has been growing sustainably since it was founded and expands into new markets frequently, making it one of the biggest food retailers in Europe. The French founded multinational retailers and wholesalers in 1959 in France (Carrefour, 2023). Carrefour's supply chain strategy centres on creating a forefront industrial ecosystem supply chain where efficiency, responsiveness and transparency are focused. Carrefour has been selling its own produced brand products since 1976. Their products appear in most of the company's product categories, such as dairy products, vegetables, fruits, pasta, eggs, clothing, etc. (Carrefour, 2023). Selling own-brand products in its stores has created a long-term relationship with its producers. Thanks to these relationships, and close collaboration, Carrefour has supported innovation and research towards its producer by implementing new agriculture technology and methods. One of these collaboration programs is the Carrefour Quality Line. Carrefour Quality Line aims to reach higher quality standards within traceability, quality, and sustainability with its food producers. In 2018 Carrefour became the first European food retailer to implement a new approach to working with traceability. Carrefour joined a blockchain-based traceability technology platform brought to them by IBM's Food Trust (Carrefour annual financial report, 2022).

IBM Food Trust comprises various modules intended to aid participants in the food system, including producers, suppliers, manufacturers, distributors, and retailers, in enhancing their supply chain efficiency through blockchain traceability technology (IBM, 2022).

This implementation gave Carrefour better control of its supply chain, and in 2022, Carrefour had blockchain traceability equipped in 69 of its sectors. By sharing traced data with its partners, Carrefour can guarantee higher food safety and quality for its customers. In 2022 Carrefour added another aspect of traceability along their supply chain where they shared traced data with the end consumer; Carrefour was the first food retailer in Europe with this solution. To meet the growing demand from consumers that ask for the origins of products and their process of ending up on a shelf in the stores, Carrefour started to label their brand products with QR codes. When a customer scans the QR code, they get provided traceable data of the product's entire life cycle, such as place of origin for the product, transportation route, quality, and organic certification. The number of products equipped with blockchain technology and a visible QR code in 2022 was 1 222 products (Carrefour annual financial report, 2022). Figure 12 describes the traceability along the Carrefour supply chain to the end consumer (Figure 12).

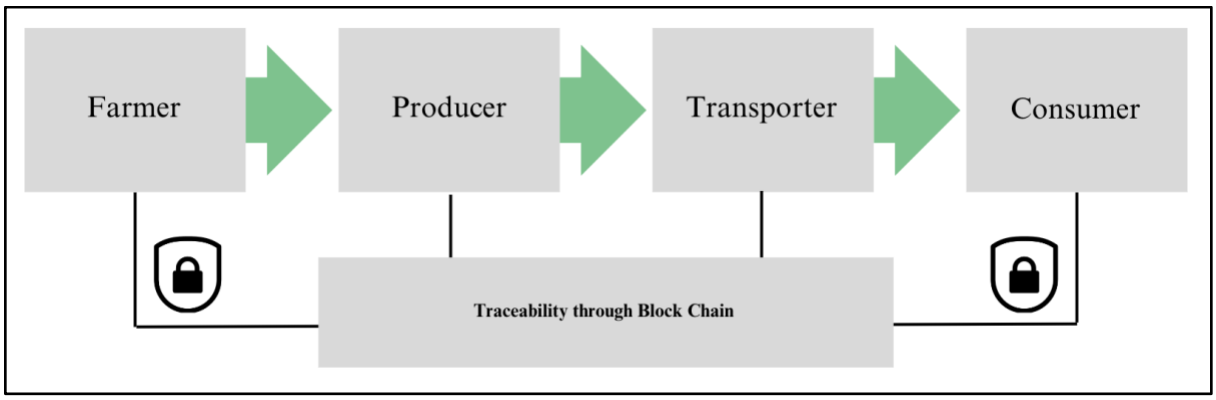

Figure 12: Carrefour supply chain

Carrefour's annual financial report (2022) shows a turning point in their costumes' behaviour where consumers' expectations are higher regarding transparency, information, and quality. Carrefour believes that one reason for this turning point could be that customers care more about making sustainable choices (Carrefour annual financial report, 2022).

4.2.1 Consumers of Carrefour

This section will present the empirical findings from interviews conducted with Carrefour consumers. Since the data analysis method is thematization, coding of the interviews was conducted and presented below (Figure 13). This has been done to get another angle to examine the case study and determine if Carrefour is meeting consumer needs when implementing

blockchain traceability technology for its products. It ended up with three themes, openness, awareness, and consumer behaviour, and will explain each in this chapter.

All the consumers have been to a Carrefour supermarket in France and have frequently been consumers of the stores. The first question asked the different consumers is if they have ever used the QR-code scanning technology at a Carrefour retailer. Consumer 1 had never done it, consumers 2 & 4 had tried it and used it a few times, and the third consumer is a more frequent user. The table below shows the thematization from interviews with the different Carrefour consumers. The codes are identified as keywords from the interviews and later collected into sub-themes. Each section in the empirical findings will be divided concerning these to state the findings clearly (Figure 13).

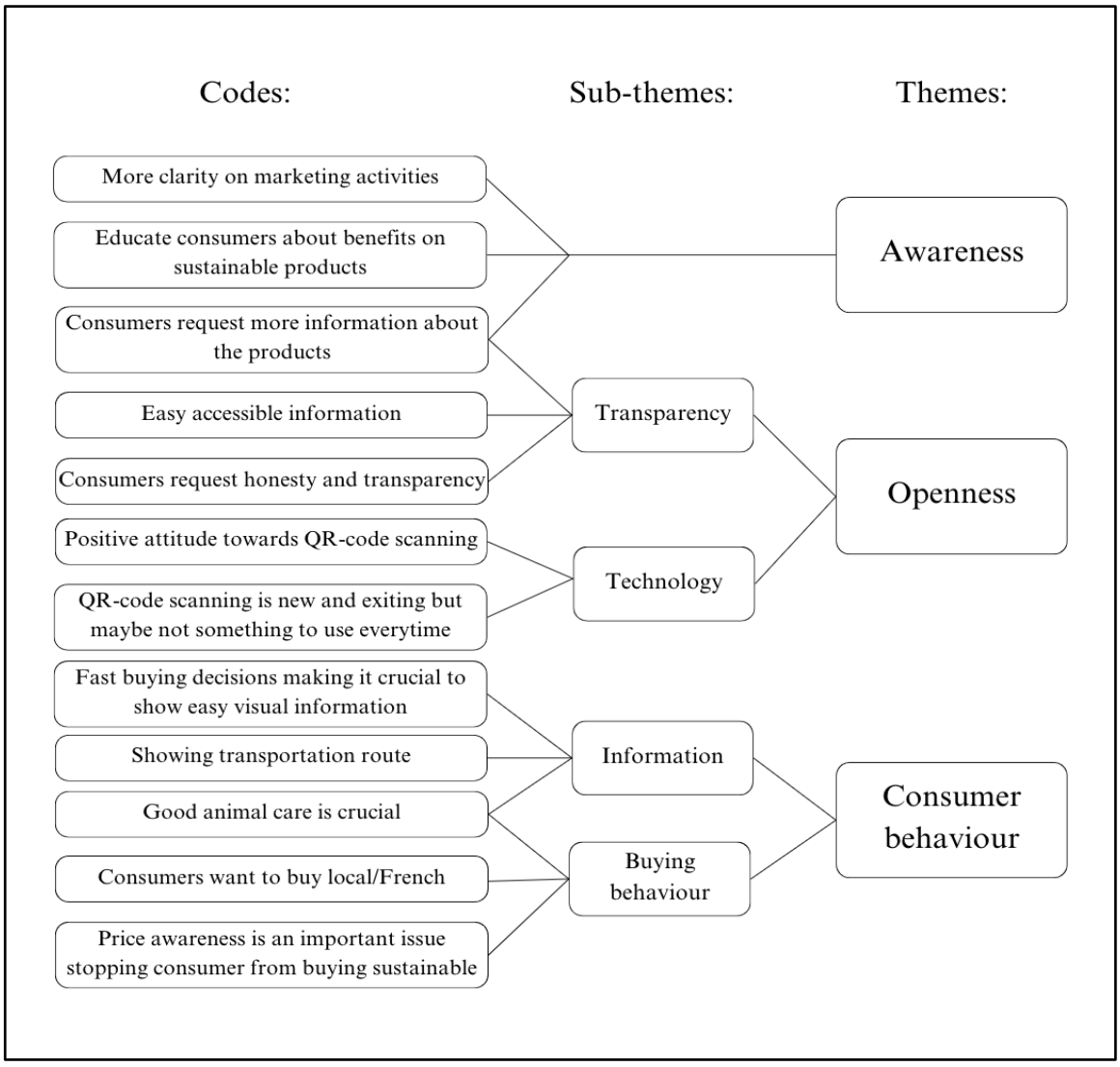

Figure 13: Thematization Consumers of Carrefour

4.2.2 Marketing

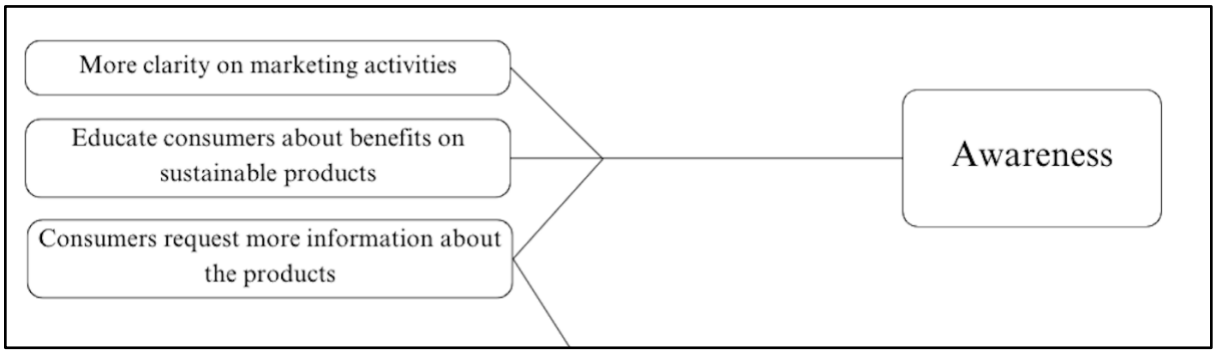

Figure 14: Thematization awareness

When talking about marketing with the consumers of Carrefour, they requested more awareness. They want information about products and want the information to be clearly stated to make it easier to understand. Another finding is that they want and must be more educated about sustainability to make sustainable choices. The findings from the interviews showed that the consumers thought the idea of QR scanning was very good and exciting. However, even though the consumers thought the technology was interesting, they used it less than we might have thought (Figure 14). When trying to figure out why they do not use it so frequently, we discovered that the biggest problem was the need for more consumer knowledge. They know they want to make good sustainable choices but must learn how to do so.

"How I as a person can benefit from it. Maybe if I had a little more information, it was actually me for the difference in how the food where it comes from and how it is produced. But right now, I don't really know what the difference is if a chicken comes from Brazil or if a chicken comes from France" (Consumer 1).

Consumer 2 is concluding the same thing, that if (s)he knew the difference between two products, it would be way easier to make a sustainable choice.

"I think I would need to become more familiar with sustainability issues. And if I would know the difference between for example a certain product route from a certain country is much worse than another. Then maybe I would start using it" (Consumer 2).

The fourth consumer also explains the importance of information. Many sustainable products are labelled with different marks, but consumers need more knowledge to understand what this means.

"They often have organic, and keyhole labelled, and all that stuff and requirements labelled and everything. But I think there is not enough information about what it actually means and what are the requirements for it. Because it feels like they can't tell you everything" (consumer 4).

When talking about the QR-scanning technology, we wanted to ask the consumers who have yet to use it what it would take for that person to start using it. The answers we got matched the assumptions we made where the marketing needed to be more precise about the benefits this can bring to the consumer.

"If it was promoted to me in some way we can say if Carrefour would really promote how I can benefit from it. You know what I mean, how I as a person can benefit from it" (Consumer 1).

The first consumer also states that to buy something, all they need is something super clear and easy to visualise; for example, it can be a red cross and a green star.
"I would just need a sign where it says a cross for a product and a green star and where it says buy me" (Consumer 1).

4.2.3 Transparency and Traceability

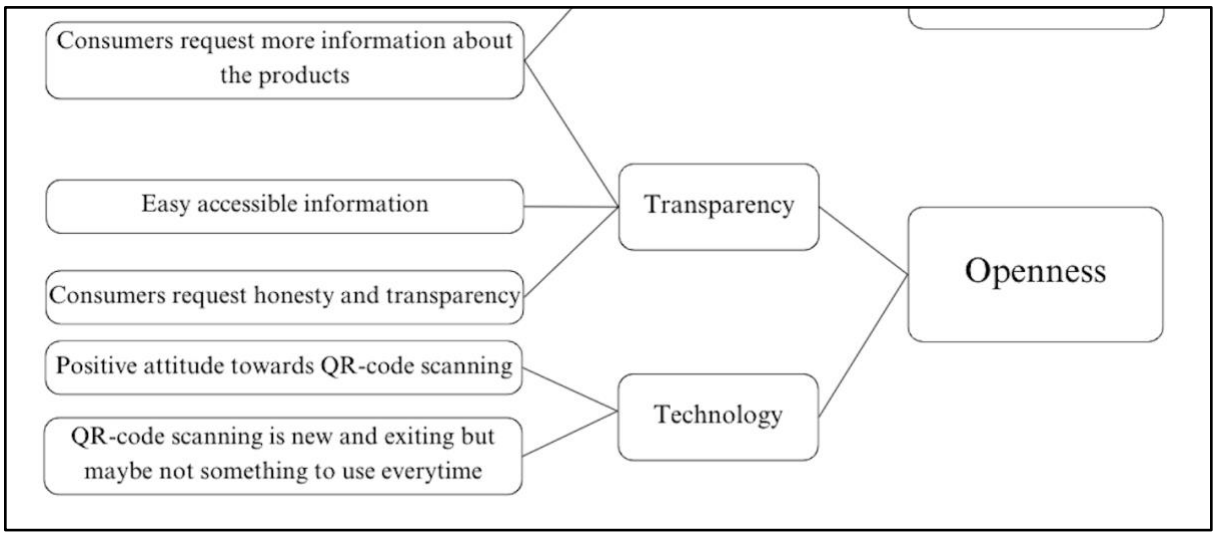

Figure 15: Thematization transparency carrefour

The figure above describes the importance of being open to consumers (Figure 15). Consumers want companies to be transparent with product information and the available data; even though they cannot take in all the information available, they still see this as a competitive advantage for the company to become more trustworthy. They also agree that QR-code scanning technology is good, even if the findings show they are willing to use it differently.

"So even if there is a lot of information, I may not be able to take in everything. But it feels like a product that shows a lot of information is more trustworthy than a product that doesn't show so much information" (Consumer 2).

When asking consumers questions about traceability, we focused on questions about the actual scanning experience. Here the answers we got differed a bit. One consumer had never used it and could not see themself using it in the future either if something does not change.

"It is easily accessible, but it still takes time for me to scan the QR code. I think maybe the brands would have benefited from making it a bit more visual in some way "(Consumer 1).

The second consumer lets us know that they had tried to use it a couple of times when it was a new, exciting thing, but it seems to be something they are willing to use only sometimes they go shopping.

"It was kind of fun the first time, but it's not something you do every... Every time you go shopping, I think the idea is very, very good. But then I don't know how much I would use it in everyday life" (consumer 2).

4.2.5 Consumer behaviour

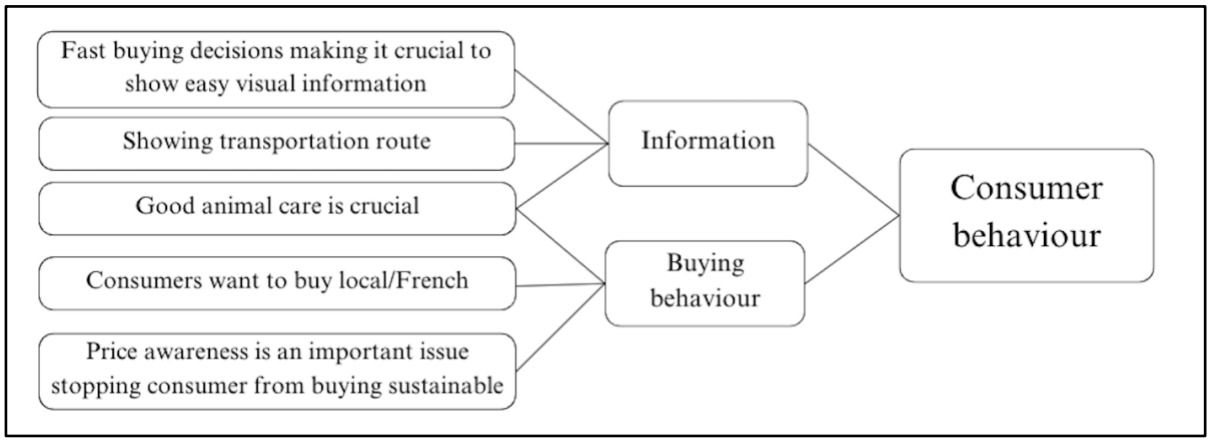

Figure 16: Thematization of consumer behaviour

Questions about what is most important when buying a product were asked to all consumers. The most frequent answer we got was the transportation route, animal care, local products, and price. This chapter will present the findings in the figure above to later analyse the opportunities and challenges blockchain traceability technology can bring to a company (Figure 16).

"I would probably say emissions and where the product comes from. That is most important to me "(Consumer 2).

All the consumers were worried about the price and the fact that more sustainable and "better" products are often more expensive. Consumer 2 states that (s)he wants to buy everything organic and ecological but often buys the cheaper products anyway.

"I'm a student, I check mostly on the price" (Consumer 1).

"I try to be as conscious as I can. You often look at prices and campaigns, and so on, instead of being sustainable. I want to buy everything organic and ecological, like that, but usually or right now anyway, it's quite expensive. So, then you might choose not to do it" (Consumer 2).

The fourth consumer agrees with the previous one. When it comes to sustainable products, they are often more expensive, which is a big excuse not to buy the products. This consumer also concludes that another big excuse for not to use the QR-code scanning technology is because it is time-consuming.

"You have to have time to be able to care about things. If you have to look at every single choice, where it has come from, then you have to have time. Time and money, I would say" (Consumer 4).

5.0 Discussion and Analysis

This part will discuss and analyse the empirical findings with consideration of previous literature to be able to later answer the two research questions about opportunities and challenges blockchain traceability technology can bring to a company's supply chain.

By interpreting the empirical findings with the theory illustrated from the literature review, the relationship and different aspects between the producer, retailer, and consumer have to be connected to analyse the challenges and opportunities in the food industry supply chains when implementing blockchain traceability technology. Different data sources will validate and discuss the data to be as reliable and accurate as possible. The analysis will be presented with consideration of triangulation throughout the entire section.

5.1 Sharing of information

After reviewing the empirical findings, there is a common comprehension between producers, retailers, and consumers that increasing transparency in a company's supply chain is essential. In theory, there is much focus on the importance of sharing information along the supply chain to the end consumer to increase transparency and enable consumers to make a conscious choice purchase that aligns with their values, such as buying Fair Trade, organic, and locally grown (Choi et al., 2020). The empirical findings and previous literature claim a demand for more traceability along the supply chain, both from producers, consumers, and retailers' perspectives (Buell & Kalkanci, 2021). The theory has shown that to reach a more transparent supply chain the information must be shared with all actors in the supply chain (Choi et al., 2020). In the empirical findings in the case of Arla, we see that the flow of information only sometimes reaches the consumer in marketing communication. The retailer Carrefour and producer Arla see themselves as very transparent. However, Arla claims that consumers only demand a little information because they cannot take in that massive amount.

The empirical finding showed that consumers could not take in as much information as provided but still see a competitive advantage in having more information available. On the other hand, Carrefour gives the consumer more insight into the products and lets them decide on their own what information they want to take in (Carrefour annual financial report, 2022). Consumers will experience the company as more transparent and reliable if they have much information and data available, even though they might need help understanding everything it says (Kang & Hustvedt, 2014).

Arla has chosen to keep their traced data more internally and not communicate detailed traced data from their supply chain operations in their marketing communication. The interviews with Arla explain that the reason for not sharing traceable interviews is the risk of it backfiring if they share too much and cannot back up what they claim. In other words, they fear being accused of greenwashing or saying something incorrectly. Arla has a lot of traceable data from their supply chain operations on their webpage in various reports, but they tend not to go into detail in their marketing communication. This raises the question of whether implementing blockchain technology would benefit a food producer like Arla as the authenticity and trustworthiness of the traced information increases (Lin et al., 2020).

5.2 Traceability approaches

As food producers and retailers, Carrefour and Arla have two approaches to working with traceability along their supply chain. Carrefour's embracement of new traceability technology and innovation along the supply chain has been an essential part of its marketing strategy. Carrefour seems to understand the importance of meeting this increasing demand as they aim to increase the number of traceable products labelled with QR-code scanning technology in the future (Carrefour annual financial report, 2022). Traceability technology becomes a way to increase competitive advantage for Carrefour. Arla, on the other hand, does not utilise this advantage. It becomes clear that the ability to make use of collected data in other areas of a business seems to be the key to implementing traceability for customers and is an excellent area of opportunity for those who implement it in other dimensions of a business, such as marketing communication (Biele, 2019).

Arla is facing more challenges when implementing traceability from the end consumer. As a producer of dairy products, this kind of implementation can result in more workload for their farmers. The challenge is how a producer already invested in a traceability approach would transition to blockchain-based technology. This could be a very complicated and costly process

and motivate them to stay with the traceability system they already implemented, even if it is less secure than a blockchain-based traceability system (Centobelli et al., 2021).

5.3 The role of blockchain

To have accurate data and be as transparent as they would like, the implementation of blockchain traceability technology could help with that. This complex problem is hard to solve, but one solution could be implementing blockchain technology along the supply chain, even though it is costly and time-consuming (Kraisintu & Zhang, 2011). This would demand a complete change and digitalization for Arla, but Carrefour has done it, so Arla should also be able to do so. When speaking with Arla's digital products manager about this, it was explained that there is a risk that it would create data chaos. The difference between Arla and Carrefour is their attitude towards new technologies and new ways of collecting data. After gaining insight into Carrefour's work with this technology, we recommend that the manager from Arla look at Carrefour's work with this to try and be more opportunistic because it is a solution that might work very well for Arla.

5.4 Marketing Strategy

Marketing is an essential part of the operation of food producers and retailers. A transparent supply chain can positively impact a company's marketing strategy (Buell & Kalkanci, 2021). Both Carrefour and Arla emphasise the importance of understanding their customers to meet their changing needs and to design campaigns and products based on their preferences. Whether it is a food producer or retailer, marketing activities such as the design of advertising campaigns increase customers' satisfaction, trust, and loyalty to achieve retention of consumers (Lin et al., 2017). The advancement of digital marketing in the shape of advertising in social media forced producers and retailers to change where they put their focus on their marketing communication (Vitsentzatou et al., 2022). With a demand for transparency in companies' operations, the producers and retailers are responsible for informing and educating the consumers, at least from the consumer's perspective.

As a retailer, Carrefour takes advantage of the advancement in marketing digitalisation as they extend their marketing communication with their scannable QR code, using their blockchain-based technology in more operations besides supply chain management (Carrefour annual financial report, 2022). This approach builds on Carrefour's perception that consumers can take in much information.

One of the main differences that the empirical findings show in the perspective of food producers and retailers is that the producers experience that consumers are examining them and therefore are being more careful of marketing claims in another way than producers. From a producer's perspective, Arla is also adapting to the change in digital marketing. The development of digital marketing has created an advertising environment where it takes more work to fight for customers' attention (Arla annual financial and sustainability report, 2022).
One can assume that producers are more careful than retailers because they risk more if they are accused of greenwashing since they operate under one brand. A retailer like Carrefour sells multiple brands (Carrefour, 2023). In the event of greenwashing accusations, the damage would be minor, and they would more easily be able to switch suppliers. However, Carrefour can back up marketing claims and dismiss false claims thanks to its blockchain-based traceability. This will lead to consumers conferring that they experience greater trust when they can see the food products journey to the shelves in a grocery store and that the more information that is provided, the more loyal they feel towards a specific brand. In other words, can a more transparent supply chain lead to greater consumer loyalty and trust, benefiting the brand's perception. To gain extra loyalty and trust, the companies that emphasise this technology must develop a good marketing strategy to educate the consumers about the products and the supply chain.

5.5 Consumer Behaviour

From the empirical findings, a consistent theme is the change in consumer behaviour and demand. Regarding consumer behaviour, Carrefour and Arla have different perceptions of how receptive their customers are to new information and how willing their customers are to change their behaviour. One aspect where this difference is clear is how Carrefour claims that its customers are open to taking more information and using new technology to meet the increasing demand for transparency. Carrefour is applying this approach for consumers by implementing its traceability technology in its marketing communication with its QR code technology (Carrefour annual financial report, 2022). This approach to new technology for consumers is beneficial for change in consumer behaviour (Szmigin & Piacentini, 2018). Arla has a different approach and works because the customer cannot take in more detailed information on the product level to increase transparency and consumer loyalty. Arla still understands the importance of meeting the demand of consumer willingness to make more sustainable purchases based on their values. In the interviews, the consumers emphasise that they are trying to make more sustainable purchases and adapt to a more sustainable purchase

behaviour approach. However, simultaneously, they confess that they are only sometimes succeeding in following their desire to do so. Factors such as economic situation, lack of time and information are barriers to committing to new behaviour in grocery consumption. Even if there is too much information for that consumers to take in, a consistent theme from the interviews with consumers is that consumers claim that more information about how a product has been produced is essential even if one not being able to understand everything, but the fact that one can check it proved that the company are working transparently. Consumers are saying this is one factor that can increase their loyalty and choose one brand over another. When analysing this from the consumers' perspective, they need a reason for what they gain from becoming familiar with the product's origin and climate impact and what they gain from choosing one product over another. So, the question is how food retailers and producers like Carrefour and Arla can demonstrate how making sustainable choices can bring more value to the consumers, for example, by highlighting quality, durability, and cost-effectiveness from a long-term perspective. This could be carried out in many different ways, for example, through consumer educational companies focusing on how everyday purchases affects the environment connecting traceability and transparency on the product level.

5.6 Opportunities

There are many opportunities that blockchain traceability technology can bring to a company's operation. Often all the possibilities have some challenges, and this section will discuss them, trying to clarify the real opportunities. Since Arla is still using this type of technology, will this section give examples of what benefits they could gain from implementing it. These implications can also fit other brands similar to Arla. One of the main opportunities is that blockchain traceability technology can use already collected data beyond the supply chain, for example, using the data as part of a food company's marketing communication strategy. From an Arla perspective, this would be a great marketing strategy since it is new and can bring a first-mover advantage, others will hear about this, and there will be more boost around the latest technology. The probability of someone choosing an Arla product over another brand will probably increase. This will lead to Arla being experienced as a more transparent company, increasing consumer trust, and making Arla look more trustworthy (Buell & Kalkanci, 2021). These QR codes often show if a product is sustainable, meaning that Arla will be more conscious of everything along the supply chain because of its visibility. They will, therefore, also look like a more sustainable brand (Biswas et al., 2017).

Implementing traceability into Arla's operations can affect the company's organisation in many dimensions. It can affect internal and external operations due to the integration of the whole value chain. By implementing traceability, Arla can get more precise and accurate traceable data thanks to smart contracts and encryption (Madhani, 2022). It will add higher levels of security, traceability, transparency, safety, and efficiency (Kshetri, 2018; Aste et al., 2017).

5.7 Challenges

With new ways of using technologies, some challenges are always present. When discussing the challenges this new way of using blockchain traceability technology can bring, we look at the obstacles that Carrefour faces and the challenges that Arla could face if they implement a technology like this. The first challenge could be that it's a bit pricey. In other words, it costs a lot of money to change the data collection process with everything from the existing technology to expertise, marketing, etc. One can still assume that even though it costs a lot of time and energy in the beginning, it's still something that will benefit them in the end since it will reduce the costs of third parties (Lin et al., 2022). Another challenge is educating consumers about what is sustainable and not, since according to our empirical findings, consumers need to learn more about sustainability to make sustainable choices. This will be both costly and time-consuming, and it will take a lot of resources, but at the same time, it will benefit them in the long run as well. Changing consumer behaviour is difficult, but other brands will want to follow their lead once it's done. The existing consumer behaviour is often to purchase products from established brands to save time or to purchase cheap products to save money.

6.0 Conclusion

In this section of the paper will our conclusion be presented; this will be an answer to the two research questions.

RQ1. "What opportunities can companies in the food industry gain by implementing blockchain traceability technology along the supply chain?"

RQ2. "What challenges can companies in the food industry face if implementing blockchain traceability technology along the supply chain?"

The conclusion will be divided into two sections to clearly state the opportunities and challenges found. The answer has emerged through literature and qualitative research with interviews and two illustrative case studies. It will contribute to our understanding of the most important aspects when implementing blockchain traceability technology for the food industry.

6.1 Opportunities

The most significant opportunity found throughout the thesis is that blockchain technology allows using authentic, collected, traceable data beyond supply chain operations to generate unique marketing strategies and increase consumer engagement and loyalty. By implementing blockchain technology a company can gain security, quick data movement, accuracy, and data privacy along the supply chain, leading to a food company being experienced as more transparent and trustworthy. Furthermore, it also shows the benefit of being the first mover in the market to create a new boost for products in the food industry. Another opportunity found is that developing a marketing strategy with the implementation of blockchain traceability technology helps the food industry act in correlation to the change in consumer behaviour and increase consumer loyalty through more detailed traced data. For example, increase purchases in sustainable products such as Fair Trade, organic, or locally grown sustainable food products to benefit the industry and the consumers.

6.2 Challenges

Price is the most significant identified challenge of implementing blockchain traceability technology in food industry supply chains. The thesis concludes that implementing new technology in the supply chain is expensive and takes a lot of energy and resources. Another challenge is the knowledge gap between the consumers in sustainability and the uncertainty that consumers need to learn what it takes to make a sustainable choice. The challenge is to encourage consumers to create a local, organic, or sustainable choice despite the higher cost of the products. The education of consumers will also require time, energy, and resources, together with a lot of expenses.

6.3 Recommendations for further research

Further research may consider the association between consumers trust, intention and purchasing behaviour in the food industry. A study of traceability implementation in marketing strategy in other sectors would help to understand patterns in how consumers are responding

to traceable data in their purchase behaviour. Further research in the area could be to conduct quantitative research to see patterns in specific regions or target audiences and how they respond to traceable data in marketing communication. Further research could investigate the probability of applying blockchain traceability technology in other industries and their supply chains.

7.0 Limitations:

This research was written during a recession, and the price of food products increased a lot during the last couple of years. This makes our research on consumer behaviour more price-oriented than during a non-recession period. Another limitation could be that the study's results could be more substantial if more food producers and retailers were willing to take part in the research and discuss this topic with us, even if we are delighted with the answers we got. A third limitation can be related to the awareness regarding traceability and transparency, where the people in the interviews might need the appropriate amount of knowledge about the topic since it's something very new for the people we managed to talk to. Another limitation can comply with the fact that the interviews were conducted in the Swedish language. These recordings were then transcribed in Swedish and later translated into English. However, it is essential to acknowledge the potential risk of losing some of the interviewees' perceptions and intentions during the translation process. To ease this concern, the authors took great care in ensuring a complete translation of all interviews, thereby striving to generate more reliable findings. Also, conducting the interviews digitally instead of in person might be a limitation; the authors needed help interpreting the participants' body language and facial expressions accurately. The interviews conducted with consumers of Carrefour were selected based on their ability to use QR-code scanning in Carrefour supermarkets. Due to this, the only criteria were the scope of people between the age of 20-30, meaning that there is a gap in perceptions from people younger and older than this. There is also a concern about the geographical location. This research has focused on the European market and may not apply to needs outside of Europe. Since the methodology is based on an illustrative case study, this thesis generalises other companies in the food industry.

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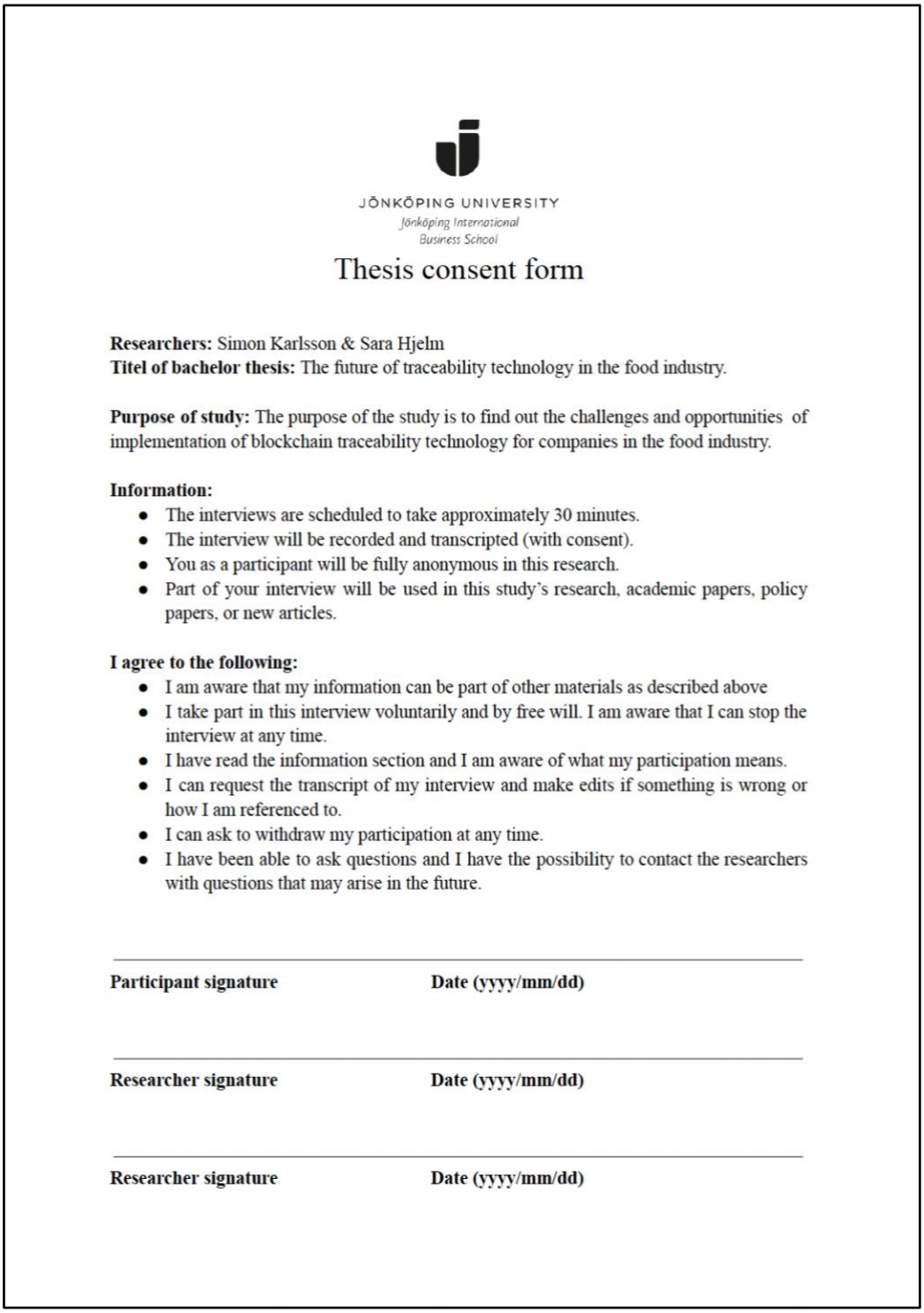
9.0 Appendix:

9.1 Appendix 1



JÖNKÖPING UNIVERSITY
Jönköping International Business School

Thesis consent form

Researchers: Simon Karlsson & Sara Hjelm
Titel of bachelor thesis: The future of traceability technology in the food industry.

Purpose of study: The purpose of the study is to find out the challenges and opportunities of implementation of blockchain traceability technology for companies in the food industry.

Information:

- The interviews are scheduled to take approximately 30 minutes.
- The interview will be recorded and transcripted (with consent).
- You as a participant will be fully anonymous in this research.
- Part of your interview will be used in this study's research, academic papers, policy papers, or new articles.

I agree to the following:

- I am aware that my information can be part of other materials as described above
- I take part in this interview voluntarily and by free will. I am aware that I can stop the interview at any time.
- I have read the information section and I am aware of what my participation means.
- I can request the transcript of my interview and make edits if something is wrong or how I am referenced to.
- I can ask to withdraw my participation at any time.
- I have been able to ask questions and I have the possibility to contact the researchers with questions that may arise in the future.

Participant signature **Date (yyyy/mm/dd)**

Researcher signature **Date (yyyy/mm/dd)**

Researcher signature **Date (yyyy/mm/dd)**