Hanh Pham

# THESIS TEMPLATE

The impact of Blockchain technology on the improvement of International Food Supply Chain: Transparency and Traceability

Thesis
Spring 2018
Business School
Bachelor Degree

SeAMK
SEINÄJOEN AMMATTIKORKEAKOULU
SEINÄJOKI UNIVERSITY OF APPLIED SCIENCES

SEINÄJOKI UNIVERSITY OF APPLIED SCIENCES

## Thesis abstract

Faculty: School of Business and Culture

Degree Programme: Bachelor of Business Administration

Specialisation: International Business

Author(s): Hanh Pham

Title of thesis: The impact of Blockchain technology on the improvement of International Food Supply Chain: Transparency and Traceability

Supervisor(s): Jorma Imppola

Year: 2018 Number of pages: 96 Number of appendices: 1

The thesis aims to investigate the impact of Blockchain technology on Food Supply Chain Management from the case study of Walmart, an American retail chain which has already adapted the technology into its product tracing system and Atria, a Finnish food company, which, on the contrary, equipped its meat tracing system without the assistance of Blockchain technology. The main objective of this thesis is to benchmark the two tracing systems, one is operated by Walmart and the other by Atria in order to figure out whether the technology can actually enhance the traceability and improve the transparency of Supply Chain network as a whole.

The literature review re-addresses the academic terms and concepts that are related to the field of research, which are Supply Chain Management, Food Supply Chain Management, the concept of Blockchain technology. In each main section, there are several subsections in which provide in-depth and more elaborate details to support the established ground of a specific theory.

The empirical research introduces and studies two real-life business cases: Walmart using IBM Food Trust™ – the management platform specialized for Food industry, developed on the basis of Blockchain technology to trace the entire journey from Mexico to the final point of purchase at Walmart stores' shelves and Atria using its in-house technology development to trace the meat and poultry product line from farm-to-fork within the Finnish market. The data are collected by conducting several semi-structure interviews with the personnel of each case company.

Differences in the scope of operation, the operation and the technology taken into usage have generally led to some significant dissimilarities between the two companies. Nevertheless, Atria can discover potential benefits and opportunities of Blockchain technology from the study and learn from Walmart's pioneer experiences on how to efficiently integrate the technology into the management of Food Supply Chain for its future plan of adaptation.

Keywords: food supply chain management, blockchain technology, traceability, transparency, food safety, food trust

# TABLE OF CONTENTS

## Tables, Figures and Pictures

## Terms and Abbreviations

| | |
|---|---|
| **API** | Application Program Interface |
| **CNS** | Central nervous system |
| **CSCMP** | Council of Supply Chain Management Professionals |
| **DEG** | Diethylene Glycol |
| **DLT** | Distributed Ledger Technology |
| **DNA** | Deoxyribonucleic acid |
| **E. Coli** | Escherichia coli bacteria cause food poisoning symptoms such as abdominal cramps and diarrhoea |
| **ERP** | Enterprise Resource Planning |
| **EU** | European Union |
| **EUROPOL** | The European Union Agency for Law Enforcement Cooperation |
| **FDA** | U.S Food and Drug Administration |
| **FSC** | Forest Stewardship Council |
| **FSCM** | Food Supply Chain Management |
| **GMO** | Genetically Modified Organisms |
| **GNP** | Gross National Product Index |
| **HACCP** | Hazard Analysis and Critical Control Points |
| **HoReCa** | Hotel Restaurant and Cafeteria |
| **INTERPOL** | The International Criminal Police Organization |
| **ISO** | International Organization for Standardization |

| | |
|---|---|
| **MSC** | Marine Stewardship Council |
| **MVE** | Minimum Viable Ecosystem |
| **MVP** | Minimum Viable Product |
| **ROI** | Return on Investment |
| **SCM** | Supply Chain Management |
| **UN Global Compact** | United Nations Global Compact |
| **WHO** | World Health Organization |

## Special Symbol

| | |
|---|---|
| € | Euro (Currency) |
| $ | US Dollar (Currency) |

# 1 INTRODUCTION

In this day and age, the importance and demand for traceability and transparency of food products along with their entire journey from farm-to-fork have increased more than ever. The consumers often claim to have little to none knowledge of what they consume on daily basis. Reports about different cases of food frauds, food crimes in association with numerous public announcements on foodborne illnesses or food contamination issues that severely damage public health and that lead to mass fatality, have raised serious doubts and insecurities among consumers. On the other hand, for those companies which aim to be consistent with healthy business practices, promote strong business ethics and develop sustainably, it is exceedingly significant to select good business partners to cooperate with. However, this case is usually easier said than done when the food supply chain network intrinsically consists of vast, convoluted web of farmers, processors, transport and logistics service providers, suppliers, retailers, distributors and storage facilities that take part in various processes of operation, including manufacturing, production, transporting or sales. In light of fact, whenever there is a movement occurs within that network, each member has a different vision of the current status and more often than not, most of the member within the chain do not have concrete knowledge on how their partners are operating. Lack of understanding on the impacts of goods and services leads consumers and businesses to indirectly support those businesses that deplete natural resources, heavily damage the environment and ecosystem, and conduct malpractices on social dimension, through the simple act of purchasing. Therefore, as an essential indicator of food product quality and decent conduct of business practices, the traceability and transparency are increasingly and broadly expected not only on consumer level but also on the corporate and governmental level in order to rebuild public confidence in the supply chain generally and in the food chain specifically.

In this blooming era of innovation and technological development, Blockchain technology is undoubtedly considered among the most revolutionary innovations that is promised to change our way of storing and securing values, data and information by cryptography. The integration of Blockchain technology to the management of

supply chain is forecasted to be a promising transformation that can disrupt the traditional implementation of Supply Chain Management by improving the traceability and transparency of Blockchain technology in the long run.

## 1.1 Research Problems

Supply chain management is understood to be critical for the survival of any organizations, regardless the characteristic of their products: tangible or intangible. This process enables an organization to operate efficiently and effectively with its aim of minimizing overall production cost and simultaneously ensure the satisfaction at peak for customers. Nevertheless, there are numerous setbacks still exist in the management & operation of supply chain network related to the traceability and transparency of the process. These setbacks can possibly bear a substantial mass of unprecedented & unexpected risks that may lead to disruption for the entire process (including inbound logistics, material management, outbound logistics) and all involved members in the network. As a matter of fact, communication between departments within the organization and throughout involved members in the supply chain, and traceability from the production-end to the hand of final customers and transparency of the operational system inside-out are listed as key factors to determine the success of a process as a whole. Taking food system as an instance, this is a complex network comprised of numerous actors including farmers, processors, distributors, retailers and a web of forwarding companies, involved to deliver solely a single food item to the final point of purchase. The method of traceability is done, varies from one to another. Each segment within the food system carries out a different method of tracking and keeping their system in control. Most members of the chain will perform the recording and tracking activities either on papers or on systems that do not interact or communicate with one another. Therefore, this setting creates frictions in practices and causes obstruction to gain full view over the entire food system. Whenever there is a food scare, or any food events spread out in a region, all foods are guilty until they are proven innocent. In fact, the economic burden as well as amount of time needed for such recalling procedures for contamination identification are apparently massive. And the underlying root of the addressed problem lies behind traceability and transparency of the system itself.

Furthermore, without an advanced and secured mean of communication, the assurance of goods flow emerging from both upstream and downstream activities could be jeopardized entirely. Furthermore, the workload for storing transaction history and related-documents between seller, buyer, the bank and other intermediaries are usually dense, time-consuming and yet uncertain to ensure the transparency, confidentiality or prevention of information leakage.

All in all, integrating the new technology to this practice is expected to be an absolute transformation for the management of supply chain system in the upcoming period.

## 1.2 Research Boundaries

The research boundaries for this thesis topic would be:

- The overview of Food Supply Chain Management, its inherent problems and risks (Supply Chain Risk Management) in term of Traceability and Transparency
- Basic introduction of Blockchain Technology and IBM Food Trust™
- The possible solutions that Blockchain Technology can offer to resolve the ongoing issues of Supply Chain system, especially in Retailing and Food & Beverage industry.
- Study the use case of Walmart in utilizing IBM Food Trust™ platform to its Food Supply Chain Management system
- Benchmarking the two tracing systems, one utilized by Walmart and the other by Atria
- Recommendations for Atria from the use case study.

However, there are certain obstacles that may hinder the author during her researching process, which can be listed as follow:

- Limitations of generalization

- Restricted access to the source of necessary information due to non-disclosure agreement
- Incompatibilities between two supply chain models and the purpose of use of two tracing systems
- Pressure on the amount of time allowed to carry the research

## 1.3 Research Methods

In order to conduct study effectively for the proposed topic, the author decided to apply the qualitative research method for the entirety of the thesis. The primary purpose of this research would be identified as Exploratory research because the field of research is rather new and seems to undergo the intensive “trial-error” phase.

The author decided to choose this research method because blockchain technology is only in its early phase of development and there has been few concrete, well-established researches/studies on its influence on the supply chain system. However, recently, IBM is building its software which is known as IBM Food Trust™ in cooperation with Walmart for Walmart’s Food Supply Chain system on the improvement of traceability and transparency. The author will conduct a one-on-one interview with the project leader of Walmart to study to understand more about the project and its conception holistically. In fact, the project IBM & Walmart has already been published Proof of Concepts for their two trials (tracking the journey of pork in China and sliced mango from Mexico). Hence, the author believes that IBM Food Trust™ could also be implemented in the operation and management system of different food companies in Finland. On this matter, the author will conduct one-to-one interview with an executive from Atria - a Finnish food company with international presence, to validate and evaluate the feasibility of the intended research.

Moreover, whitepapers, scientific articles from different reliable sources of information and studies on different business cases that the technology had been successfully executed upon would also be collected and analysed by the author, with the aim of acquiring more knowledge on the field as well as keeping the thesis work up-to-date.

# 2 THEORETICAL FRAMEWORK

## 2.1 SUPPLY CHAIN MANAGEMENT

It is perceived as a common practice in the vast majority of industries that the consumer products and services are conceptualized as supply chains. In fact, each different stage in the whole production process, counting from the farming of raw materials to the delivery of final products to end-user, is considered a link in the entire chain.

In today modern business world, according to Lambert (2008, 99), the competition of modern business management is no longer surrounding between autonomous entities, however, would rather be between supply chains.

Supply Chain Management (SCM) has been an integral part in the operation of every business. It has been playing a significant role in defining company competitive advantages, contributing to company successes and boosting customer satisfaction now and then. Various definitions of SCM from different perspectives of professionals in field will be revisited on top of the explanation of key concepts of SCM.

### 2.1.1 Definition

Over the past decade has seen a significant change of paradigm shifts in supply chain management, from the traditional arm's-length and those adversarial relationships in which in the past, usually characterize buyer/supplier relationships. The proper management of co-operation, distribution and gaining of trust as well as recognition are the emphasis of supply chain management as the "whole can be greater than the sum of its parts".

Opara L.U. (2003, p. 101-102) regards the definition of Supply chain management (SCM) based on a study of Woods (1999, p.6) as,

> the management of the entire set of production, manufacturing/transformations, distribution and marketing activities by which a consumer is supplied with a desired product.

This concept of Supply Chain Management is also criticised to be relatable to the term “demand chain management”, due to its emphasis on meeting consumer expectations. Opara later *cited* from another study carried out by Hobbs, J.E. (1996, p.15-17) that

> The practice of SCM encompasses the disciplines of economics, marketing, logistics and organizational behaviour to study how supply chains are organized and how institutional arrangements influence industry efficiency, competitions and profitability

Christopher (2011, 3) adopted the definition Supply Chain Management in a concise manner, that can be illustrated as follow:

> “The management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole.”

Lambert (2008, 99) referred “the management of multiple relationships across the supply chain” as Supply Chain Management. *He* strictly claimed that a chain of businesses with one-to-one or business-to-business relationships is not considered as the supply chain, but it is “a network of multiple businesses and relationship”. In essence, Supply Chain Management not only represents a new approach to manage the business and its relationships with involved participants in the entire chain but also deals with total business process excellence.

In another argument, Waters (2007, 35) discussed that there is a problem in relation to any aspects of Supply Chain Management is that when referring to the concept, people tend to use different terms for the same meaning, otherwise imply different meanings to the same terms. The reason behind this circumstance is caused by the emergence of “a combination of formerly distinct disciplines” and in fact, each single discipline is all displayed in a distinct term and idea. Consequently, for different people, terms and definitions are yet likely to mean, or at least imply, different things.

On the other hand, Supply Chain Management is described by the Council of Supply Chain Management Professionals (CSCMP) in the United States (2012) as “the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities”. Furthermore, the collaboration

and coordination between different channel partners, including suppliers, intermediaries, third-party service providers and customers are also taken into account when defining SCM. Briefly, the council concluded that SCM is the integration of supply and demand management “within and across companies”.

Additionally, a chain of facilities and distribution alternatives in which functioning the obtainment of products, transforming these products into intermediate and finished goods as well as distributing these intermediate, finished goods to customers – was defined as Supply Chain Management (Ganeshan and Harrison Terry,1995). As stated in an academic article, published in 1995 by Lee H. L. and Billington, C., Supply Chain Management is determined to incorporate the integration of activities that occur between facilities network in which consisted of the acquisition of raw material, transformation of those materials into intermediate products, then to final goods and the delivery of these goods to customers via a distribution system.

Kay (2001) has demonstrated Supply Chain Management in a simple and comprehensible manner, in which he claimed that this management activity allows an organization to get the right goods and services to a pre-defined destination at the right time, in the appropriate quantity and at a satisfactory cost. The efficient management over this process requires

> overseeing relationships with suppliers and customers, controlling inventory, forecasting demand and getting constant feedback on what's happening at every link in the chain.

Not to mention, Simchi-Levi, D., Kaminsky, P. and Simchi-Levi, E. (2003) discussed Supply Chain Management in detail as

> a set of methods used to effectively coordinate suppliers, producers, depots, and stores, so that commodity is produced and distributed at the correct quantities, to the correct locations, and at the correct time, in order to reduce system costs while satisfying service level requirements. The fundamental notion of these definitions is that a Supply Chain must be controlled in order to be fast and trustworthy, cost-effective, and flexible enough to meet customers’ requirements.

Along these lines, SCM is believed to be primarily responsible for connecting major business functions and business process within and across involved organizations

as an integrating function with the aim to achieve high efficiency and optimal performance for the business model (see figure1). Additionally, Christopher (1998) believes that the management's ability to consolidate the complex network of business relationships of the company will determine the ultimate success for the business that lie within. Therefore, a more holistic view of a firm is better depicted from the perspective of SCM.

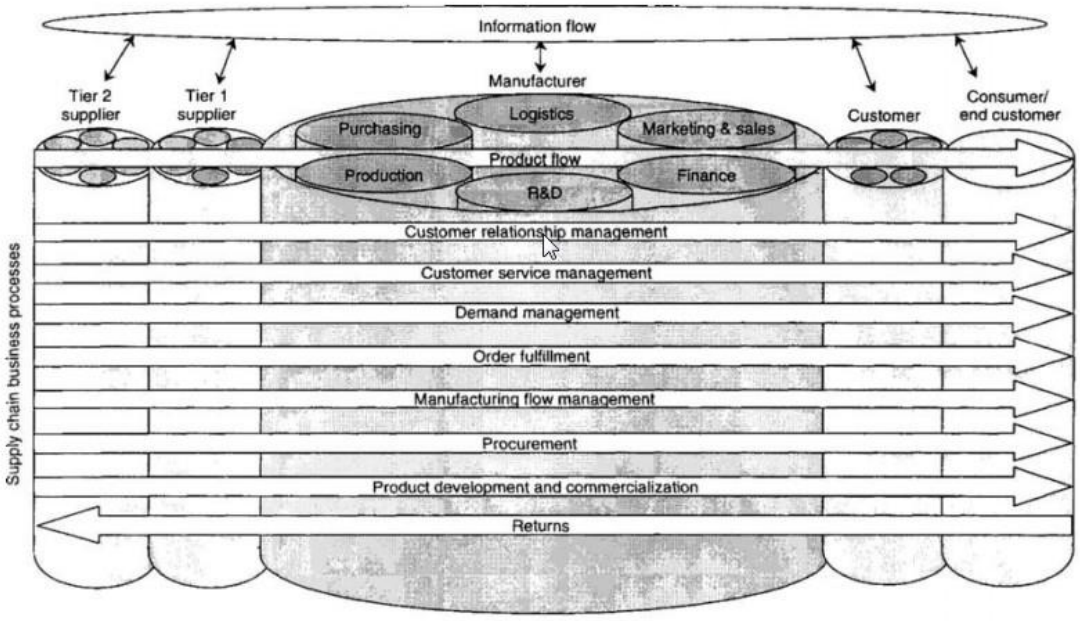


*Figure 6. Integrating and managing business process across the supply chain (Cooper et al., 1997b)*

### 2.1.2 Supply Chain vs Logistics

To some extent, certain confusion can be caused while utilizing interchangeably those terms of "Supply Chain", "Supply chain management" and "Logistics" as one of the terms may be used under the concept and definition of the others.

Christopher (2011,13) explained the concept of Supply Chain as the network of organisations that are engaged through various processes and activities of upstream and downstream connections, in which produce value for the products and services that serve the final-end consumer.

Furtherly stated by Waters (2007, 37), the supply chain comprises a sequence of activities and organization to which materials movement takes place, throughout the journey from original suppliers to ultimate customers. Dated back to 1998, Aitken extended the approach towards supply chain under a more precise definition

> A network of connected and interdependent organisations mutually and co-operatively working together to control, manage and improve the flow of materials and information from suppliers to end users.

A broader glance toward the definition of this term is introduced by the Institute of Logistics (1998, 8) describing supply chain as the series of events whose intention is to satisfy a customer.

Besides, Peck (2006) added in that supply chain is

> The flow of materials, goods and information (including money), that pass within and between organisations, linked by a range of tangible and intangible facilitators, including relationships, processes, activities, and integrated information systems

Considering the term more profoundly, Cooper, Lambert and Pagh (1997, 2) indicate the total journey of materials ‘from dirt-to-dirt’ as the supply chain. Going across this entire journey, materials possibly travel through different stages and are handled by different involved parties within the network of supply chain, for instance, from raw material extractors or growers to raw materials merchants, then carried on by shippers, processors, transport companies to the hands of manufacturers, finishing operations, distributors, logistics centres, warehouses, wholesalers, retailers – forwarding to a whole range of other facilitators. Progressively, supply chain widens its scope over final customer by adding the phase of recycling, recovery of materials and reuse.

Logistics is, otherwise, illustrated to be responsible as a management function, for all material movements. An inbound, or in other words, inward logistics is understood to be the movement of materials into an organization from suppliers. In contrast, outbound or, outward logistics is the movement of materials out of an organization, distributing on to its customers. Generally, the movement of materials within the organization is known as materials management (Waters. 2007, 36).

This entire process of logistics and material movement is clearly demonstrated via the following figure.

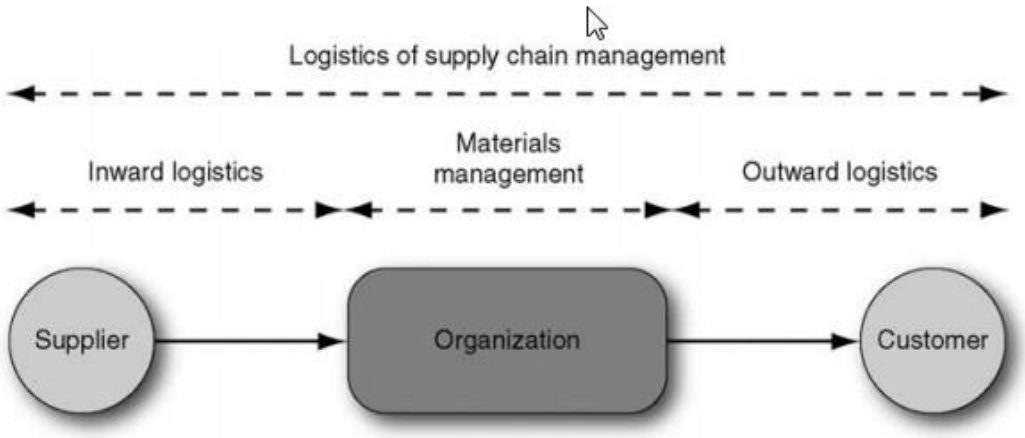


*Figure 7. Logistics of Supply Chain Management (Waters, 2007)*

In a general interpretation, logistics is argued to be the movement of goods, services, and, occasionally, people in an organized pattern. The significance of logistics strengths and capabilities was originally realized as key determinants under the military use when it is referred to the process of supplying combat and troop support. In trade term, logistics deals with the product's physical movement among one or several participants within the supply chain. (Wood D., Barone A., Murphy P. and Wardlow D. 2002, 1)

Explaining logistics under a management and more sophisticated perspective, Christopher (2011,2) proposed that logistics is a strategic process to which extent, optimally "managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows)" throughout an organisation and its marketing channels to make the most out of the profitability in term of present and future run for that organisation over the cost-effective accomplishment of order.

The definition of Logistics by Council of Supply Chain Management Professionals (CSCMP) was given under the emerging distinction between Supply Chain Management, in which explicitly clarified the position of logistics management as a segment within supply chain management, that

> plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements.

Notwithstanding, logistics management has a distinct definition in comparison to logistics activities since the term is referred to a wider scope than the execution of a single activity and it seems to be taken part in all aspects of planning and execution, including strategic, operational and tactical. Logistics management is an integrating function that manages all logistics activities in an optimal way and establish linkages between logistics activities and other functional departments in the organisation.

Essentially, logistics functions as a planning orientation and framework that aims to design a single plan for the product and information flow through a business (Christopher 2011, 2)

### 2.1.3 Structure of a Supply Chain

Initially, Lambert D. (2008) has clearly defined the supply chain network structure as the linkage between member firms within the network and the member firms themselves.

According to Waters (2007,38), the comprehensive and less complicated way to view the supply chain as a whole is to have a single product moving through a sequence of organizations and each of the movement gives additional value to the product. The focus organization - whose point of view is taken into account, having activities before it (in which materials moving towards the organization) are called Upstream and those in which come after the organization are called Downstream (see figure 3)

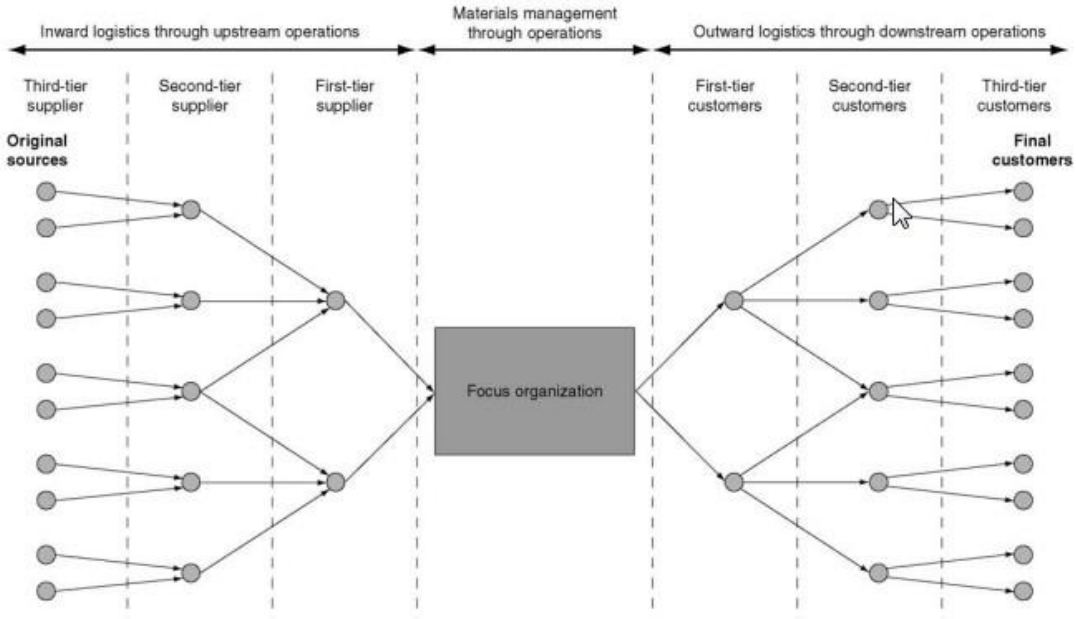


*Figure 8. Structure of Supply Chain Network (Waters, 2007)*

Tiers of suppliers are divided in the upstream activities whereas a first-tier supplier is defined as the supplier which sends materials straight to the organization and the second-tier supplier is the one that sends materials straight to first-tier supplier. This dividing process continues back to the original sources. Likewise, customers are also categorized in the same manner, as tiers. The customer in which the focus organization sends products directly to, is called first-tier customer and the second-tier customer is the one that receives product directly from a first-tier customer. This dividing process continues until to the final customers. An instance can be extracted to illustrate the participant roles of upstream activities as followed: sub-assembly constructors can be considered as first-tier suppliers of a manufacturer, its second-tier suppliers can be component makers and third-tier suppliers can be material providers. Similarly, applying the same principle to downstream phase, the wholesalers can be seen as first-tier customers, retailers as second-tier customers and third-tier customers are those end-users.

Sharing a close view on the structure of Supply Chain, Grant, Trautrims & Wong (2015, 9) defined a simplified Supply Chain structure and its relevant factors as demonstrated in the figure 4. In this diagram, there is no clarification for upstream

and downstream activities in comparison to the model introduced formerly by *Waters.* Nevertheless, the explanation of involved participants by *Grant et al*. are somewhat identical as the group of authors described that first-tier supplier of the first-tier supplier and first-tier customer of the first-tier customer are respectively the second-tier supplier and second-tier customer of the focal firm. However, there is a minor addition to the chain in this case as among each supply chain node, where the focal firm is represented as a node, the phase when “goods are moved by transportation”, it is known as ‘Go’ activities meanwhile, that phase when “goods are stored and/or processed at each node in storage”, it is called ‘Stop” activities. According to *Grant et al.,* even though details of each ‘Go’ or ‘Stop’ activity are rather complex, yet these two forms of activity are what logistics and SCM are about.

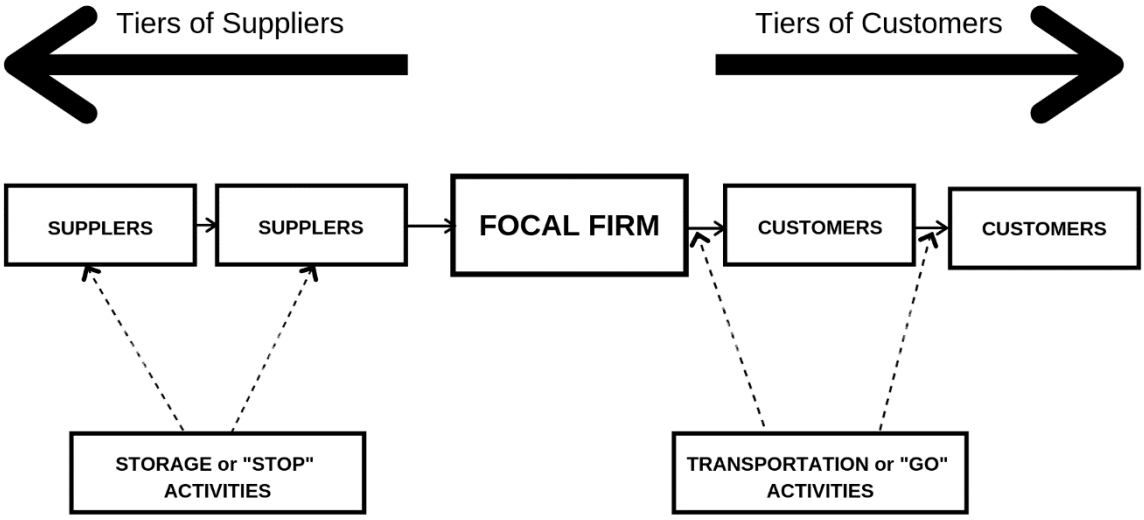


*Figure 9. Simplified Supply Chain Structure (Grant et al., 2015)*

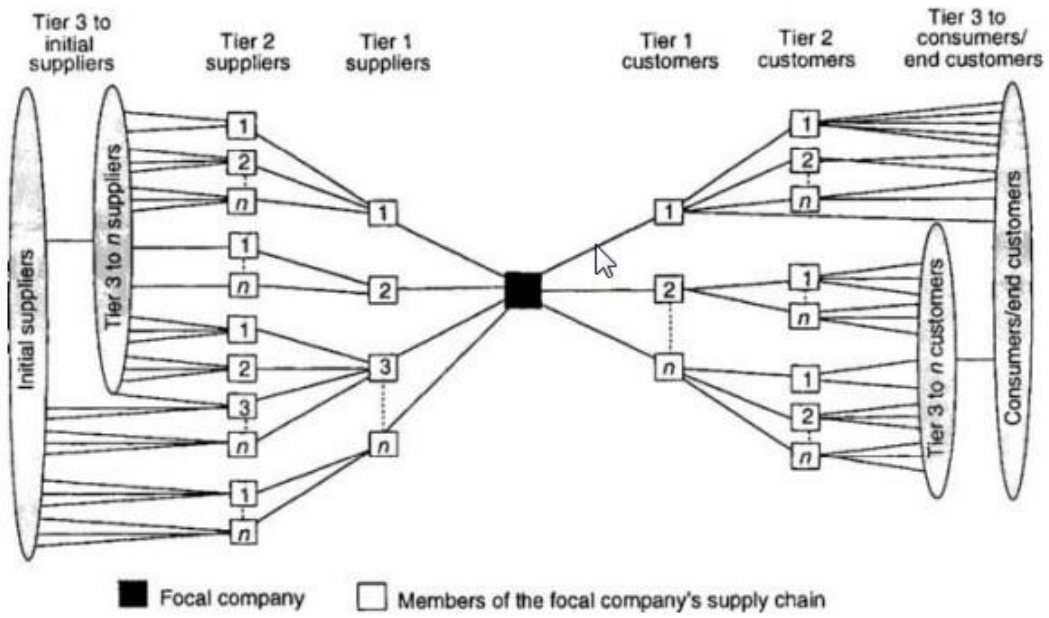


*Figure 10. Supply Chain Network Structure (Lambert et al., 1998a)*

According to a research paper carried out by Lambert (2008), every firm participates in a supply chain, from the stage of procuring raw materials to the hand of end-consumer, each and one of them is considered to be an important node within the network. The workload for management of the supply chain relies on numerous certain criteria, which can be the availability of raw materials, the quantity of available suppliers and how sophisticated the product is. In the same scope for consideration, the length of supply chain and the number of suppliers and customers at each tier can be taken into account. At different stages and points of time within the supply chain, the proximity of relationship will differ since it is not necessarily that all nodes across the supply chain must be closely correlated and integrated. Cooper and Gardner (1993) has clearly stated that the relationship which best fits to the specific set of circumstances, is the most proper relationship to manage. It is crucial to acquire knowledge and consolidate the understanding on the configuration of the supply chain network structure.

The most essential factor when it comes to the point of configure supply chain network structure is to primarily identify who are the members involved in the supply chain. By sorting out who are the key players in the network, this technique tends to help firms to strategically allocate managerial attention and resources.

Considering under the view point of a focal firm, members of a supply chain are consisted of all companies/organizations which interacts in a direct or indirect manner with it, over its suppliers/customers from the point of origin to the point of consumption. Notwithstanding, it is advisable to divide the involved members into 2 distinct clusters of primary and supporting members for the plain purpose of simplifying the complex supply chain network. The definition of each groups is introduced by conducting several interviews and discussions with members of The Global Supply Chain Forum, conducted by Davenport (1993).

Primary members of a supply chain are

> all those autonomous companies or strategic business units who carry out value-adding activities (operational and/or managerial) in the business processes designed to produce a specific output for a particular customer or market.

Contrary to the definition of primary members, supporting members of a supply chain are

> companies that simply provide resources, knowledge, utilities, or assets for the primary members of the supply chain

Examples of primary and supporting members can be demonstrated as follow: bank (supporting member) lends money to the retailers (primary member), food equipment manufacturer (supporting member) supplies manufacturing equipment to a food production company (primary member) and so on.

The point of origin and point of consumption of the supply chain can be illustrated under a comprehensible definition by taking primary and supporting members to the portrait, that is the point where no previous primary suppliers exist and “all suppliers to the point of origin members are solely supporting members “, is so-called the point of origin. Meanwhile, the point where no additional value is added and the finished goods and/or services is consumed, is defined to be the point of consumption.

As a matter of fact, the supply chains involve intertwined sets of interacting firms of enormous complexity. Due to the inherent complexity, the term “supply chain” raised a debate among many people as the majority assumed that this term simply gives

in significantly broad view and it would be more accurate to discuss the term as “supply networks”, “supply/demand networks” or “supply webs”. However, Porter (1985) argued otherwise, that “supply networks” or “supply networks” have the tendency of referring to “a logistics channel to emphasize marketing, a process to emphasize operations, a value chain to emphasize value added and a demand chain to emphasize customer satisfaction”. Nonetheless, whichever term should be used to denote this concept, the fundamental principle to overlook the picture holistically is to understand that supply chain consisted of highly sophisticated route of movements between connected participants.

### 2.1.4 Impact of Supply Chain Management on competitive and organizational performance

Based on a study by Hall (1993), two of the most significantly crucial factors in determining the operational performance are the supply chain structures and the methods of interaction between organizations.

S Li; B Ragu-Nathanb, T.S. Ragu-Nathanb and S. Subba Rao (2004) proposed the definition of competitive advantage as the extent that an organization can build up an impregnable position over its competitors. The term comprehends capabilities and competencies in which favor the organization to distinguish itself from its competitors in the field and it is the result of “critical management decisions”.

In a research study carried out by Christopher (2011, p14-15), *he* pointed out that formerly, the relationships among participants in upstream segment, which are suppliers and downstream segment, which consists of customers (a prominent example in this case can be mentioned as distributors and retailers) were often considered as adversarial instead of being cooperative. This circumstance still exists in many cases of today business that can be illustrated over the picture of some firms seeking certain gains in cost reductions or profit improvement at the expense of their supply chain partners. In fact, those firms did not realize that the total ultimate cost paid by final-customer will have the tendency to rise and the final marketplace would effectively reflect this effect because the cost in that chain is simply transferred from one partner to another. Therefore, this cost-transferring strategy does not make

those firms appear to be any more competitive eventually. As opposed to only seeking for optimization in one's profit, it would be prudent to pursue the competitiveness improvement throughout the entire supply chain by adding value and minimizing cost in overall. The study showed that those leading-edge companies have come to realized that the real competition occurs between supply chain against supply chain rather than solely between companies. Furthermore, Christopher made clear of his point, denoting that the concept of supply chain management is the extension in the reasoning pattern of logistics. *He* claimed that optimising flows within the organisation is the primary concern of logistics management while supply chain management acknowledges that internal integration by itself is inadequate.

As discussed above, in the present, companies no longer perform independently in the competition with other alike "stand-alone" companies. Moreover, there has been an increasing demand for "value delivery systems" that are more adaptive and responsive to ever-changing markets and simultaneously, more stable and trustworthy to the task of value delivery. This demand call for a focus on the supply chain as a whole in order to obtain these goals. Therefore, managing core business better than competitors at a more cost-effective approach than competitors is argued as the key determinant for achieving competitive advantage in the race and the principal mission for the organisations with the aim of creating excellent value for their customers and consumers. For simplicity, core business are those activities, including "new product development, supplier development, order fulfilment and customer management". (Christopher, 2011 p15-16).

As a supplementary argument to the discussion, Christopher (2011) stated that one capability that is concerned to be essential for success in the market lies in the concept of supply chain agility. In reality, when the product life cycles shorten, just-in-time practices are adopted by customers and markets of sellers turn into buyer's, it is apparent that the ability of the organisation to quickly and flexibly respond to demand yields a powerful competitive edge.

For simplicity, possessing a competitive advantage proposes that the organization is equipped with unique, in-house capabilities and competencies to compete in comparison to their opponents in the field. Those advantages are various and can be one or combination of many, for example, low price, high quality, high dependability

and/or short delivery time. Consequently, such capabilities allow organization to enhance its performance, in general. Better economic performance, high level of customer satisfaction and loyalty, and relationship effectiveness are the set of benefits gained through competitive advantage. As an illustration to the stated assertion, an organization which has shorter time-to-market and fast product innovation have the tendency to be benefitted from a higher proportion in market share and larger sales volume. High quality product is not subjected to the struggle of charging premium prices and in turn, the organization is able to observe the surge in profit margin on sales and return on investment (ROI). Moreover, those well-recognized brands with better indication of customer loyalty are less likely to encounter challenges when altering their targeted sectors. Hence, sales and profitability increase.

Likewise, Li et al. (2004) suggested that organizational performance alludes to "'how well an organization achieves its market-oriented goals as well as its financial goals". Increasing productivity, minimizing inventory and cycle time are referred as the short-term objectives of Supply Chain Management. On the other hand, increasing market shares and profits for every participant of the supply chain, are the aims for Supply Chain Management's long-term objectives.

Supply Chain management (SCM) practices contribute significant influence on the success of an organization, in both dimensions of organizational performance as well as competitive advantage. The competitive advantage is expected to be enhanced by the means of price/cost, quality, delivery dependability, time to market and product innovation. Different elements of SCM practices have the tendency to affect different aspects of competitive advantage. As an instance, supplier performance tends to be improved, time to market decreases and the degree of customer responsiveness and satisfaction increases through strategic supplier partnership. The improvement in customer satisfaction and partnership quality is claimed to be the result of information sharing and information quality. By empowering organizations to launch products into market rapidly and perform dependable delivery, information sharing gives rise to high levels of supply chain integration. Along with that, postponement strategy emphasizing on the increase of the flexibility in the supply chain as well as balancing global efficiency and customer responsiveness. (Li et al, 2004).

## 2.2 FOOD SUPPLY CHAIN MANAGEMENT

Food Supply Chain Management is the concept invented in order to illustrate all of those activities or operations related to production, distribution and consumption for the sake of maintaining the safety and the quality of different food under efficient and effective methods (Marsden et al., 2000; Blandon et al., 2009). Food Supply Chain Management can be distinguished from other brand of supply chains, for example furniture logistics and supply chain management, by its distinctive prerequisites as the food quality, safety, and freshness within limited time. These influential factors complexify the food supply chain and make it more difficult to manage (La Scalia et al., 2016). This section of the theoretical framework will review several different aspects within the field of Food Supply Chain Management for a broader view over the term (definition of Food Supply Chain and Food Logistics) and the overall outlook as well as risk management of Food Supply Chain on a global scale. The importance of traceability and transparency to the Food Supply Chain Management system is also addressed.

### 2.2.1 Definition of Food Supply Chain

In actual fact, the human existence on the planet relies heavily on the food supply chains. Regardless of the operational scale of the chain whether if it is domestic or international, the significance of the entire chain operation is placed on the availability of the food at the right time, with the right quality and right quantity. Therefore, in order to have a better grasp of the whole “Food Supply Chain” concept, it is essential to primarily go through the definition and fundamentals of this area.

The term “Food Supply Chain” can be simply comprehended as the processes of transforming raw, unrefined food materials from farm into safe, edible food items to our dining table throughout those processes that are consisted of multi-layer stages of actions including production, processing, distribution, consumption and disposal. The food supply chain model is often described as the operation in a “domino-like”

fashion, or in another word “two-way causality” between the upstream and downstream network, where if one member of the chain is affected, the consequences will impact the whole food supply chain. This effect will likely be manifested in the fluctuation of the price of the goods (see figure 7).

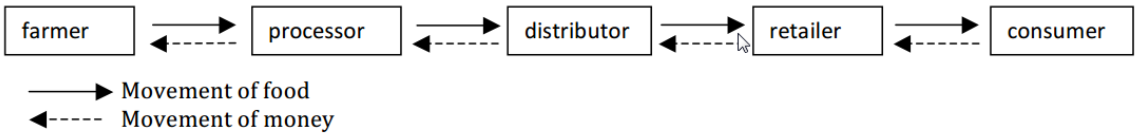


*Figure 11. Movements of food & money in a simplified Food Supply Chain model (Harvard University)*

Another point of view carried out by Dani (2015) has a different approach in defining the Food Supply Chain by clarifying the key actors within the chain and its individual influence over the chain totality (Figure 7). Neither posing a different theory nor a complicated perspective than the definition stated in the previous paragraph, Dani delineated the Food Supply Chain as

> “the series of processes, operations and entities that help to take the food from its raw material state to our plates”.

The chain is a sophisticated network of interconnected entities cooperating to ensure the availability of the food supply rather than a singular chain, defined only by certain entities. It begins with the producer, which is often an agriculture-focused organization then the food sourced at this phase will be handled through numerous processing methods by different food manufacturers (or processors) depending on the needs and the demands of different market segments. The movement is executed by a host of freight forwarders, logistics and transportation companies so that the foods will reach the consumers at the right quality as well as on-time delivery.

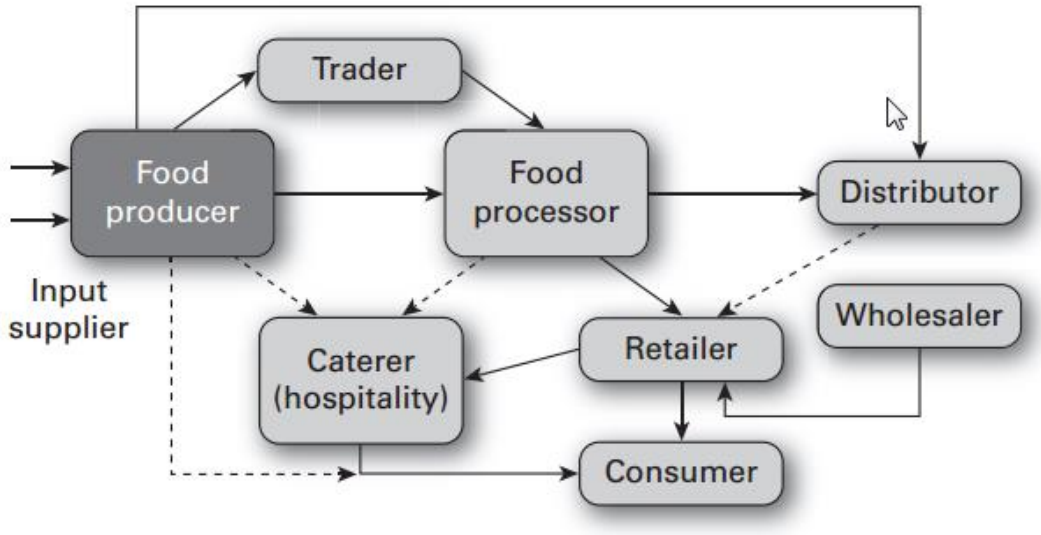


*Figure 12. Actors in Food Supply Chain Management (Dani, 2015)*

A focal definition of the food supply chain has been given by Folkers and Koehorst (1998, according to Beske et al. 2014, 134) as

> "a set of interdependent companies that work closely together to manage the flow of goods and services along the value-added chains of agricultural and food products, in order to realize superior customer value at the lowest possible cost".

### 2.2.2 Food Logistics (Agricultural Product Logistics)

Food logistics is considered to be "the movement of food" across the supply chain to the point where it is delivered to the plate of the consumers and the information flow from the consumer side back into the chain.

From a wider perspective, food logistics can be defined under the definition of "Agricultural products-based logistics". According to a research paper carried out by Li, Zhou, Wang (2012), agricultural products logistics stated to be the combination of various entities ranging from the producer to the receiver and those related technology, organization, management and other fundamental functions. The referred term is composed of a sequence of connections, including "agricultural production, purchase, transport, storage, loading and unloading, handling, packaging, distribution, circulation processing, information activities, etc. and realizing agricultural product appreciation and organization objectives in the process".

Sharing a corresponding, but more meticulous view upon the subject, Wang (2012) denoted that agricultural products logistics is obviously a part of the logistics industry, in which indicates the physical flows of physical entities and involved information from producer to consumer in pursuance of satisfying the consumer demand. The entire process of agricultural products logistics is consisted of “agricultural production, acquisition, transportation, storage, loading and unloading, handling, packaging, distribution processing, distribution, and information activities”, with the ultimate objectives are to increase the value-added for agricultural products, reduce the distribution costs as well as avoidable losses (to some degree avoid market risks), and enhance circulation efficiency.

Having a slightly different approach from the previous definitions, with a more detailed look upon the major benefits of logistics, Tan (2012, p.106-107) refers logistics in agricultures as interconnected activities within the process which performance is to improve the quality of agricultural products. The primary aims of agricultural products logistics are claimed to enhance, control and assure the quality of agricultural products; lessen the economic burden of operational costs; optimize the resources allocation; improve and protect the welfare of the environment and act as a key driver to alter the development of agricultural product logistics to a green, sustainable approach (green logistics).

Putting under a more practical context, Shufeng et al. (2010, p2188-2192) described 12 functional elements of modern agriculture logistics as follow “procurement, supply, storage, transportation, loading and unloading, sorting, pack-aging, distribution, distribution processing, marketing, recycling, and information control”. Mentioning about the task assigned to agriculture logistics, the group of authors has shifted attention not solely to the reduction of logistics cost and avoiding the logistics operating risks, but also to perform researches on how to promote and smoothly cooperate all of those involved functional elements in order to maximize the revenue stream, agricultural economic benefits (such as improving the income and ensuring fair trade rights for farmers, diminishing agricultural production cost) and push forward the modern agricultural economic development.

Inherently, logistics is about integration, not only in the small-scale of a single entity (a company) but also involving external parties, for instance, suppliers, logistics services providers and customers. As a matter of fact, in the modern retail logistics, the capacity of working in a cooperative manner with other individuals and companies in addition to the strong partnerships/alliances are the determinants of success. Not only that, logistics is also about the movement of goods, which in this case, are food and agricultural products. The favourable outcome of the system will be assessed based on the on-time delivery, keeping to the customers' specifications. (Dani, 2015 p.70)

In the totality of logistics system, food chain logistics takes over as a crucial component. As reported by the European Commission (2010), the Food & Beverage industry is evaluated to be one of the most significant and dynamic industrial sectors within European region, in which providing jobs for more than 4 million people through its active employment channel of 300,000 companies. In addition, the Food industry is responsible as one of the key contributing factors to the Gross National Product Index (GNP) of many economies, predominantly in the developing nations.

### 2.2.3 International Food Supply Chain

a. International Food Supply Chain

According to Gardner, T.A. et al (2018), trading commodities on a global scale has been the mainstay of many world's economies

Nowadays, when the food supply chains are increasingly operated on the global scale, and the movement of foods is not anymore restricted in only domestic area where it was used to be sourced directly from a local farm to the shop, with only a few to none intermediaries, but now includes a sophisticated web of involved stakeholders within the supply chain and a host of highly complicated procedures to navigate crosswise international confines.

Dani (2015, p. 85) claimed in his study that the appearance of agile logistics, organized retail environments and improvements in strengthening regulations of the food industry, have enabled consumers worldwide to gain access to fresh agricultural

products throughout the year. Even though the local (seasonal) varieties against the food miles is proven to be more advantageous, agricultural supply chains are making attempts to coordinate with retailers and importers on a global scale to meet the new demands from consumers around the world. Due to the fact that foreign borders are no longer the confinement to consumer demands, therefore, the requirement for operational systems to facilitate the international trade at reduced cost and competitive prices, are in demand for the operating firms within the supply chains. In reality, advanced information technologies permit the quick responses from operators to changes in consumer demand as well as further goods flow in nowadays sophisticated global marketplace.

Another aspect to be mentioned in the study research of Dani (2015) on International Supply Chain, is about the design of international food supply chains, in which it is suggested that the sustainability factor needed to be taken into consideration. The aim of which, is to guarantee the regional development in the two dimensions of sustainability, including social and environmental in association with the measures of accomplishing economic stability, by stimulating the development the development of local agro-industry, generating employment, promoting local food production, adding values to products, introducing new technologies, increasing export earnings while reducing product losses and improving food safety and nutrition in the mean of joining chain partners and their activities (Roekel, J.V., 2002)

b. Challenges in International Food Supply Chain

The expansion of global supply chains has disabled the ability of tracing back to the original causes of many consequences made by multinational companies' actions (Zyglidopoulos and Fleming, 2011, p. 695). Bruckner, M. et al. (2015) discussed that "global supply chains increasingly cross multiple regional and regulatory borders, and the ensuing complexity of material and monetary flows can precipitate myriad unintended effects and telecouplings"

Entering the international food trade is often seen as challenging due to its stringent certification standards, such as phytosanitary certificate, ISO certificate, HACCP (Hazard Analysis and Critical Control Points), trade barriers including tariffs or non-tariff barriers to trade and strict regulations. Bringing the developing countries and

emerging economies into view, the communication and training opportunities for involved parties (farmers, producers, forwarders, distributors and retailers) within the supply chains are sub-standard to some extent. Consequently, the trading companies must encounter specific hindrances in adapting to the changes in consumer's demands and requirements from government bodies (Dani, S., 2015, p.85).

The fragmented nature of supply chain is the main factor that hinders the full traceability of the food products and creates a lack of communication between actors within the food supply chain. This challenge turns into even a more severe and complicated scenario when the trade occurs on a massive scale, across borders worldwide. Taking one of the most seemingly simple food items into consideration, it can be seen that there are numerous involved actors that extend over different continents around the world with "little to no knowledge of one another's actions" (Crossey, S., 2017).

Moreover, lack of transparency is one of the most distressed topic in the global food market since the food supply chain, has been described previously, as a highly complicated network and it is particularly difficult to conceptualize what really happened to the food item along its journey from farm-to-fork. According to Yiannas, F. (2017) stated in his interview that there is a unique product tracing system that differs from each producer to each retailer. Most of those systems are often done on papers, hand-written forms or on the system which does not "speak to each other". Rogers, S. (2017) further added that "The fundamental problem with supply chains is that information is captured in silos". The issue arises when an item moves from a producer's system and is input into another's, whereas there is no traceability or connection between the two systems. To cite an instance from the article published by Crossey, S. (2017), tracing a hamburger to its provenance may involve tracing back to the lettuce farm where the lettuce leaves were grown and processed, tracing the beef back to the cattle and other logistical limitations. All of these procedures are extremely complicated to execute, time-consuming and costly as Yiannas, F. (2017) mentioned that "retailers and food suppliers can spend millions of man-hours a year on food traceability."

Additionally, there is a notorious influence from organized criminal activities in relation to food and the fraudulent manufacture of food, which also put the global supply

chain in jeopardy and even more pressure on the demand for traceability of products from the consumer.

### 2.2.4 Food Fraud, Food Crimes and Food Scandals

1. Food Fraud and Food Crime

Annually, food fraud is a global problem that costs approximately 30 to 40 billion US dollars to the global industry and has a significant impact on consumer confidence when it comes to making purchase decisions on food items (PwC report, 2016). The statistics collected in a 2015 report from World Health Organization, has stated that it is estimated that the health of nearly 1 in 10 people is negatively affected from consuming contaminated food yearly. The Center for Disease Control provides a figure stating that there are approximately 48 million Americans become ill on an annual basis, as a result of eating contaminated food. Furthermore, there is a rising concern over organized crime body, which is also known as “Agromafia”, and its involvement in food industry.

In food scandals and food-related issues, two terms “Food Fraud” and “Food Crime” are frequently used interchangeably, nevertheless, they are distinguished in nature. The term “Food Fraud” is introduced by professor Elliott, C. (2014) based on the definition delineated by Food Standards Agency as

> Food fraud encompasses deliberate and intentional substitution, addition, tampering, or misrepresentation of food, food ingredients, or food packaging; or false or misleading statements made about a product for economic gain. The types of fraud include adulteration, tampering, product overrun, theft, diversion, simulation, and counterfeiting

Meanwhile, professor Elliott, C. proposed that the concept of “Food Crime” is formed when a food fraud

> no longer involves a few random acts by ‘rogues’ within the food industry but becomes an organised activity perpetrated by groups who knowingly set out to deceive and or injure those purchasing a food product.

During the period from the starting November 2015 to the end of February 2016, a wide-scale operation named OPSON V in which involved 57 countries including 23 EU Member States and 34 non-EU countries, 21 private companies, with the association of INTERPOL and EUROPOL, carried out checks and investigations on “high risk entities in the food and beverage supply chains”. The overall statistics provided in the framework of the operation was: “more than 4,054 inspections and checks were carried out, 3,567 administrative and criminal cases were initiated, 1,793 suspects and 41 arrests were reported” and “in total, 11,131.18 tonnes, 1,449,056.40 litres and 5,549,328 units of food and beverages have been seized” (Interpol and Europol, 2016). Noticeably, these figures illustrate the ongoing problems with food frauds and food crimes in the global food trades and simultaneously emphasize on the importance of traceability and transparency across the entire food supply chain.

2. Food Fraud and Food Crime cases

a) Horsemeat scandals in United Kingdom (UK) – 2013

In 2013, a meat scandal was discovered in Europe, in which the meat products advertised as containing beef meat were in reality, claimed by BBC News (2013), contained “undeclared or improperly declared horse meat – as much as 100% of the meat content in some cases”. Findus, a frozen food brand established in Sweden, was required to test its beef lasagne products and 11 out of 18 tested products were found to contain approximately from 60% to 100% horsemeat. In addition, Liffey meats was also involved in supplying products with evidence of horse DNA, to supermarkets and food retailers. The discovery of this scandal was stated to be reported on 15 January 2013 in an article published The Telegraph (2013), when horse DNA had been revealed in frozen burgers traded in numerous Irish and British supermarkets  ABP Food Group, the meat supplier of Burger King – the American fast food chain (Gleeson, C., 2013), Tesco - British multinational groceries and general merchandise retailer and Aldi - German discount supermarket chains, was accused for trading and supplying meat contaminated with horsemeat. This resulted in “ten million suspect burgers“ were removed from the fast food chains and the store shelves.

In point of fact, the scandal raised concern about consumer health and well-being as the horses are usually given phenylbutazone, a drug used to relieve pain and treat fevers for the animal, however, potentially have side-effects on human health (McKie, R., 2013). Nonetheless, McKie (according to Eliott, C., 2013) further commented on his article that the amount of phenylbutazone ingested from a horsemeat burger that can result in aplastic anaemia is insignificant.

This event majorly caused financial losses and damages to the involved businesses within the meat trade but had an inconsiderable risk to the public health. Since the revelation about the investigation of this wine scandal, no casualties or illnesses were reported

b) Diluted milk adulterated with melamine in China (Milk Powder that contains toxic chemical substances)

Before 2008, melamine was a term only well-known to the chemist (Pei, X. et al, 2010), however, after the scandal of milk powder specialized for infants found adulterated with melamine, consumers gain perception over this chemical substance. According to a study research conducted by Lipschitz, W.L. and Stokey, E. (1945), Melamine is defined as “nitrogen-rich organic compound and an intermediate chemical frequently used for the manufacture of fertilizers, plastics, laminates, paints and adhesives” that in combination with cyanuric acid can cause “acute renal failure” (Puschner et al., 2007). The ingestion of melamine in human can result in “reproductive damage and bladder or kidney stones” (Pei, X. et al, 2010).

The motive behind the milk adulteration was to “increase the nitrogen content of the milk” and thus, yield a higher measure of protein content after the water had been added to raw milk in order to increase its volume (explained by WHO). This act was aim to pass the inspection of protein level via an examination of nitrogen content from companies which utilize the milk for further production.

In 2008, sixteen infants were diagnosed with kidney stones in Gansu Province, China and all of them were found to had been fed milk powder which was contaminated with melamine. The findings of formula milk powder adulterated with melamine was known to cause “the kidney illness in approximately 300,000 infants and the known deaths of at least six infants” (Spencer, R., 2009) and 54,000 babies were

reported to be hospitalized in the same crisis period, in which depicted the serious consequences to the public health that impacted by the food fraud. Pinpointed as the chief culprit, The Sanlu Group, one of the largest dairy producers in China (Huang Y., 2014), was accused to be liable for the damage caused.

c) Adulterated Austrian dry-sweet wine scandal – 1985

In 1985, a notorious incident happened in Austrian wine production industry, where several wineries adulterated their sweet wine with diethylene glycol (DEG), a chemical substance that “used in the commercial preparation of antifreeze, brake fluid, cigarettes, and some dyes” (Sebastian M., 2009). Described in a case report, studied by Muhammed, H. et al. (2018), DEG is a “colourless, odourless liquid with a sweet taste” and “is metabolised, in a similar fashion to other toxic alcohols” that affect central nervous system (CNS), heart, respiratory system, liver, pancreas, and kidneys (Sebastian, M., 2009) . This substance is claimed to have high level of toxicity and it is prohibited to use in foods and drugs.

According to Tagliablue (1985), in 1985, The Bureau of Alcohol, Tobacco and Firearms reported that there were 12 wines brands imported from Austria to the United States, found contaminated with diethylene glycol. In fact, this toxic substance was used as a sweetening agent in the winemaking process. From an expertise point of view, “wines are given a quality level based on the length of time the grapes spent on the vine and the quality of the grapes, so the sweeter the wine the better the quality” (Casco, 2015) and therefore, fetch a higher price.

Since after the World War II until 1985, Austria was a main sweet wine exporter to German market, where it received two-thirds of the wine exports from Austrian vintners ship. In the 1970s, numerous wine traders signed “lucrative contracts” with major supermarket chains and liquor shops in West Germany and other places in order to provide great quantity of sweet Austrian wine, “at constant levels of quality” (Tagliabue, J., according to Friedrich Huemer of the Wine Industry Fund, 1985). A climate change event occurred in Austria in the early 1980s, harnessed the grape farming business of the country. The quality of the grapes was not qualified to the standard, which resulted in the thin and sour wine batches, and inadequate supply of good quality wine being produced, as agreed in the requirements of the contracts.

Consequently, the winemakers decided to improve the sub-standard wine batches by adding sweeteners. However, regular (typical) sweetener were unable to deliver the sense of high quality wine, meanwhile, diethylene glycol (DEG) were able to do so and beyond that, create a full-bodied texture with dry taste to the wine. Therefore, since then, diethylene glycol (DEG) had been introduced into the list of ingredients.

The discovery of wine contamination with DEG was established in 1985, from a supermarket in Stuttgart. The subject of investigation was a 1983 Rüster Auslese. Soon, after the findings of this toxic adulteration scheme, an official health warning opposed to the consumption of Austrian wines was issued by the Federal Ministry of Health. The news of the scandal was widespread across German media and was released throughout the world.

Since the revelation about the investigation of this wine scandal, no casualties or illnesses were reported.

d) Spinach Outbreaks in United States

In 2006, there was a Spinach outbreak occurred in the United States due to the contamination of E. Coli 157 in the Spinach baby leaves packages distributed nationwide in the retail store in USA. According to the report of Center for Disease Control and Prevention of USA, there were 199 documented cases reported, 31 Hemolytic-Uremic Syndrome[1] diagnosed, 3 deaths recorded, and the outbreak spread across over 26 states with over 50% of reported cases required hospitalization. Epidemiologists soon discovered the outbreak was caused by a bacterium called E.Coli 157 from fresh spinach products. On September 15, 2016, U.S Food and Drug Administration (FDA) announced to the general public about the contaminated fresh spinach products and aware consumers not to consume spinach until further notice. All the spinach products were recalled nationwide from every retailer in the US until the authority would be able to pinpoint the origin of the contaminated product. The time duration for the FDA to trace back that contaminated spinach to the original farm was 2 weeks and the result was pointed back to only 1 product lot of 1 supplier (1 farm) with only 1 date production. However, in the 2 weeks of attempting to discover the origin of the outbreak, the spinach farmers, suppliers and

[1] Hemolytic-Uremic Syndrome Severe kidney failure

producers were under serious harm of livelihood due to the inefficient tracing procedures (Centers for Disease Control and Prevention, 2006)

### 2.2.5 Importance of Traceability and Transparency

Food crises and the increasing incidence of food-related safety hazards and scares, like footh-and-mouth disease, mad cow disease, microbial contamination of fresh produce, dioxin in poultry etc., along with the presence of genetically modified organisms (GMOs) (Opara, L.U., 2003) and other environmental pollution phenomena around the globe, for example, dioxin pollution, classical swine fever or avian influenza and so on (W. van Plaggenhoef, 2007), have created serious doubts and insecurities among the consumers when it comes to making purchase decision on food items – the necessity that directly affect consumer's health and well-being. The consumers are concerning about food quality and the safety of food production systems more than ever. The urge for such information related to "the origins and processes of food procurement, safety levels, production methods, hygiene, use of genetically modified feed, application of pesticides, and other environmental issues like food miles and carbon footprints" (Trienekens, J. et al., 2009) has driven the operating firms with motivation of disclosing the required information in a transparent manner, in addition to the integration of traceability along the complete journey of the product from farm-to-fork.

Yet, among the biggest hindrances that obscure the full traceability in Food Supply Chain is the fragmented nature that bears with it. As a matter of fact, speaking of a single, simple food item, it involves numerous of actors that needed to be source and trace on a global scale and one actor within the chain can hardly gain any knowledge of one another's presence and actions.

Two terms "transparency" and "traceability" are the fundamental concepts for an effective management and sustainable development of supply chain strategies. These two terms are usually used interchangeably in the area of logistics and supply chain even though their definition is viewed differently from one to another.

Regarding to the term “traceability” Antoniol, G., et al. (2001, p.331-355) and. Keith, L.H. (1994, p. 590A-591A) denoted that the application of traceability in various fields of operation is wide-ranging. The UN Global Compact gives the meaning of traceability as

> the ability to identify and trace the history, distribution, location and application of products, parts and materials, to ensure the reliability of sustainability claims, in the areas of human rights, labor (including health and safety), the environment and anti-corruption

In relation to food products, Opara, L.U and Mazaud, F. (2001, p.239-247) pointed out that traceability signifies the capability of identifying the provenance of the products or in other words, the sources of input materials where the products were originally farmed and sourced, along with the capabilities of determining the exact location and precise life history (activities) of the products within the supply chain by conducting full backward and forward tracking through the help of instruments that ““records and follows the trail as products, parts, and materials come from suppliers and are processed and ultimately distributed as end products”(United Nations Economic Commission for Europe, 2013). Within the same context, the two authors also discussed a broader view over the agricultural traceability, as follows

> Agricultural traceability simply refers to the collection, documentation, maintenance, and application of information related to all processes in the supply chain in a manner that provides guarantee to the consumer and other stakeholders on the origin, location and life history of a product as well as assisting in crises management in the event of a safety and quality breach.

Opara L.U proposed in her study that by contributing “the communication linkage for identifying, verifying and isolating sources of noncompliance to agreed standards and customer expectations”, traceability added value to the general quality management system. Richero, R. and Ferrigno, S. (2017, p.15-16) supplement the benefits of traceability in the manner that provides visibility to processes, as well as permits further inspection “beyond the products, into the suppliers, the business environment, and the corporate social responsibility”.

In the opinion of Egels-Zandén, N. et al. (2014), transparency of a supply chain, or in other words, Supply Chain transparency is frequently defined differently from one

scholar literature to another, even though commonly referred. Egels-Zandén, N. and Sörum, N. (2015) indicated that there are two fashions of defining Supply Chain Transparency in existing literature. The former fashion is to regard supply chain transparency as equivalent to traceability, such as the trackability of product's flow from end-to-end of the production process and supply chain (Egels-Zandén, N. and Sörum, N., 2015, p.5-6). The latter one, Cramer (2008, p.395-400) emphasized that supply chain transparency concerns the disclosure of sustainability conditions at suppliers.

It is stated by Fair Labor Association that supply chain transparency denotes the availability of information regarding company's suppliers and their location, in which made readily accessible to end users and other actors in the supply chain. Transparency of supply chain has gained dominance since its importance has grown significantly as a response to the demand of consumers for knowledge of product's and service's origin in which they purchase, in addition to the increase in campaign for better transparency from civil society organizations.

Approaching the definition of "Supply Chain Transparency" at a more general but scientific glance, Hofstede, G.J. et al. (2004) explain that

> Transparency of a supply chain is the degree of shared understanding of and access to product-related information as requested by a supply chain's stakeholders without loss, noise, delay, or distortion

Under the view of Opara, L.U. and Mazaud, F. (2001, p. 239-247), by using verifiable records and labeling, traceability is seen to contribute significantly to the illustration of supply chain transparency. Unlike transparency which intention is to sketch out the picture of entire supply chain network, traceability affords a view over "individual batches of components or purchase orders" throughout the progress of the supply chain (SGS, 2018).

When consumers make decision on selecting any food items, there is definitely an unspoken expectation is that their choice of consumption must be ensured with respect to the safety and high-quality standards of those selected items. Regarding to a matter of fact, whenever there is a pandemic event related directly to food or any foodborne illnesses occur, all foods are claimed to be guilty until they are proven

innocent by being tracked down to its provenance. As mentioned in the previous section of the thesis, there are plentiful of real-life examples for food scandals that those food products are not guaranteed with the premium quality as they are claimed to be, and it is an undeniable fact that foods affect directly on the consumer's health & well-being. Therefore, the consumers are often left with doubts and confusions when making purchase decisions, especially on food products since they are incapable of gaining access to the actual view over the totality of the food supply chain. That is alone, standing on consumer's point of view, but there are as well other stakeholders that should be taken into account as their products and roles within the chain can also be affected tremendously if the transparency and traceability of the entire chain are not provided. Hence, risk management in this case, would be more difficult to control and plan out.

a) Consumer-driven value chains

In consumer industries, supply chains have evolved into a highly complex network that created a struggle for firms to even name the suppliers taken part in the production activities (Boström et al., 2012; Doorey, 2011), not to mention having knowledge over the quality assurance process as well as sustainability conditions at the manufacturing sites of the suppliers. Thus, stakeholders are now placing their concern seriously on the transparency in global supply chain since it enables organizations and companies to supervise the working conditions at production sites (Laudal, 2010). As a result, transparency in case of consumer-driven supply chain is well-aware of, among participated parties within the chain, in which every information disclosed must be credible, trackable, traceable and auditable.

As claimed by Chapman (1995, p.139-142), supply chain transparency is generally portrayed as a mean of allowing stakeholders, for instance, consumers, to make informed assessments of companies' products and practices.

The argument determining whether if the consumers leverage transparency to place companies under pressure, is discussed by Egels-Zandén, N. and Sörum, N according to the study researches published by Boström and Klintman (2011); Connolly and Prothero (2008); Lekakis (2013); Horne (2009); Micheletti (2003); Young

et al., (2010), as strictly related to a more extensive discussion of increased consumer demand for sustainable products. Furthermore, sustainability issues and sustainability concerns that are connected to consumption patterns are urging consumers' actions to be taken. Consumers must thoroughly take into consideration an excessive amount of sustainability labels (Pedersen and Neergaard, 2006), and also have to be aware of "greenwashing" (Peattie and Crane, 2005) as well as updating up-to-date environmental and social issues; and manage uncertainties. The term "Greenwashing" is mentioned by Marquis, C. and Cuili, Q. (2014, p.14) , in which refers to

> "a strategy similar to decoupling, whereby firms overemphasize positive aspects of their environmental records to mask their actual performance."

Tight engagement to environmental and social justice and consumer resources, for example financial means, information and knowledge are accounted as two prominent factors in which sustainable consumption depends on (Egels-Zandén, N. and Sörum, N., 2015), along with the opportunity to commit in green consumption (Moisander, 2007).

Consumer-driven value chains nowadays shift the focus majorly on customer's and directly on the customer's demands, in which consumers are now pushing companies to provide consistency, customization and transparency. This approach allows companies to transforming their business model into a "consumer-centric" one that understand better and react effectively to customer's behaviours as well as their purchase decision-making process.

Food identity and traceability are considered as extremely crucial elements for consumer-driven chains because they directly influence the well-being of the consumers. The characteristics of food products circulate within commodity market and those traded within the retail environment are distinct in identity. However, it has been witnessed an alteration in direction of products from commodity world to retail environment. For instance, coffee nowadays, are branded and promoted as gourmet coffee, in association with the close partnership and cooperation between processors and suppliers. On the other hand, food items traded in retail environment

are “processed, branded and work effectively on the basis of uniformity in processing and high quality “. The consumer-driven chain is operated mainly on the basis of cooperation and collaboration; and it is rather more regulated, sometimes vertically integrated than the commodity chain.

Integrating the cutting-edge technology into the tracking and tracing system is requisite to keep the system functioning effectively and operate efficiently. This will enhance consumer’s knowledge of real-time information on the products’ quality and safety status. Furthermore, on the corporate’s point of view, traceability and transparency will facilitate fast recalls with less economic burden whenever there is a breach in quality and safety standards.

b) Improving sustainability

By disclosing the information in a transparent fashion and integrating traceability system into the operation management of the supply chain, the firms not only demonstrate their interest to protect the consumers but also to “prove claims and attributes of their sustainable products”, “advance sustainability” (UN Global Compact, 2014, p.7) and distinguish themselves strategically from other competitors in the field. Traceability and transparency allow consumers and stakeholders to verify and ascertain sustainability claims from companies about both of tangible (commodities) and intangible products (services), with the aim of ensuring healthy practices on both significant indicators of sustainability, which are social and environmental aspects in the supply chains (Beier, J., 2014).

As discussed, for the consumer industries, the prominent characteristic of supply chains is the high level of complexity that obstruct the view of firms over the totality of the entire chain, not to mention ensuring the sustainability practices. The agriculture and retail industries can be taken as an exemplar of a highly sophisticated supply chains. Sustainability certification schemes, for instance, Forest Stewardship Council (FSC) which demonstrates that the certified wood and paper products are originated from responsibly managed forests; or Marine Stewardship Council (MSC) which promotes the sustainable fishing practices that certifies the fish has been caught in a sustainable manner, without overfishing or causing damage to nature, “have enabled the development of credible and robust chains of custody standards”

(Beier, J., 2014). The two schemes, in fact, make clear that the crucial component of the audit process lies in the traceability and transparency of how these timber and seafood products are sourced, processed, handled and delivered to the end-users. This, in fact, have made a positive impact on the sustainable development for the two industries.

Further down the line, Rueda, X., et al. (2016) determined the essential factor of making a sound and knowledgeable decision on investment and sustainable sourcing strategies in order to mitigate risks within the supply chains and positively leverage the conditions at where the production activities are suspected to be malpractice and unsustainable, is the access to information. The kind of information that inform precisely on how any particular production region, its sustainability conditions and obstacles involved with that region are interconnected to a given supply chain actor within the chain. It is evidenced that such information can be beneficial to both consumers as well as producers and suppliers in term of making informed choices on the purchased products and adopting improved standards (Egels-Zandén & Hansson, 2015). Thus, the fundamental ground to establish alliances and partnerships, for example, roundtables and industry-wide agreements, for sustainability is as well, the credible information (Gardner, T.A. et al., 2018).

## 2.3 BLOCKCHAIN TECHNOLOGY

As the central of this thesis revolves around the impact of Blockchain technology, therefore, providing fundamental understanding of related terminology is crucial. This section will define the Blockchain technology and its main characteristics to gain a general overview of the concept. Besides, the distinguish between permissioned and permission-less blockchain will be discussed along with the introduction of HyperLedger Fabric, the underlying technology for the development of IBM Food Trust™. Furthermore, the additional applications of Blockchain technology in field of Traceability and Transparency, and the comparison between traditional governance of record and Blockchain-based governance of record will also be addressed elaborately to provide a concrete theoretical framework for the concept of Blockchain technology, on which the research will be based.

### 2.3.1 Overview of Blockchain Technology

a) Blockchain Technology

Androulaki et al. (2018) elaborately defined blockchain as

> is an immutable transaction ledger, maintained within a distributed network of peer nodes. These nodes each maintain a copy of the ledger by applying transactions that have been validated by a consensus protocol, grouped into blocks that include a hash that bind each block to the preceding block. (see the illustration via Figure 8)

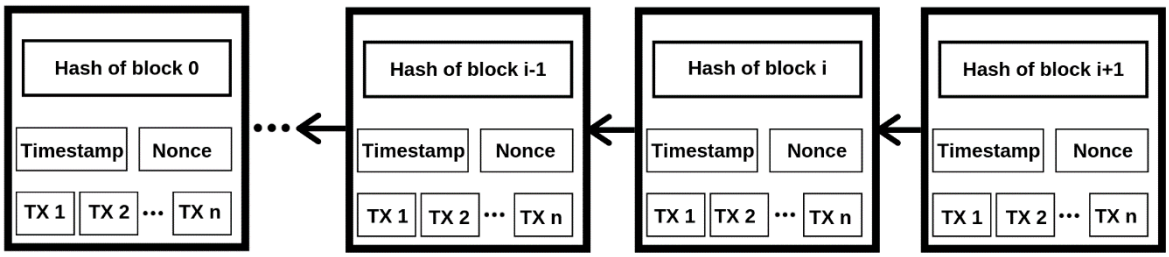


*Figure 13. Blockchain Model (Zheng, Z., et al, 2018)*

All committed transactions executed within the peer-to-peer network operated by Blockchain, are archived in a chain of blocks and can be referred as a public ledger. Whenever there are new blocks append to the chain, it constantly enlarges (Zheng et al., 2018). The blockchain can also be seen as a sequence of blocks that accommodates a complete transaction records list (Lee, K.C., 2015).

Blockchain could be regarded as a public ledger, in which all committed transactions are stored in a chain of blocks (Zheng et al., 2018). This chain continuously grows when new blocks are appended to it. The blockchain is a sequence of blocks, which

holds a complete list of transaction records like conventional public ledger (Lee Kuo Chuen, 2015)

According to a research paper published by Wright and Primavera (2015), Blockchain is described as both a database as well as a network, with “distributed, shared, encrypted” characteristics and acts as an immutable and “incorruptible repository of information” that once entered and recorded, is unable to be changed or deleted (Wegner, A., 2013). Blockchain is “equipped with built-in security and internal integrity” (Wright and Primavera, 2015) and categorized as a type of Distributed Ledger Technology (DLT).

Mougavar and Buterin (2016) proposed in their study an in-depth and multi-aspect definition of blockchain based on three dimensions, involving technical, business and legal factors, as follow

> Technically, the blockchain is a back-end database that maintains a distributed ledger can be inspected openly. Business-wise, the blockchain is an exchange network for moving transactions, value, assets between peers, without the assistance of intermediaries. Legally speaking, the blockchain validates transactions, replacing previous trusted entities.

Providing an elaborated view on the subject, Brakeville and Perepa did not see Blockchain solely as a database, as discussed by Wright and Primavera (2015), but rather as a digital ledger that permanently “records transactions in a public or private peer-to-peer network” as well as all the “history of asset exchanges” occurred within the network, in a “sequential chain of cryptographic hash-linked blocks”. The technology is claimed to be “tamper-evident” and “distributed” to all involved “member nodes” inside the network system in order to ensure transparency, traceability and auditability to each authorized member. It is further explained that the term “Blockchain” is derived from its primary working principle, in which from the start of the chain up until the most recent block, every confirmed and validated transaction block is “linked” and “chained” to each other. Therefore, blockchain can function in a reliable manner that allow member nodes (members) in the blockchain network to access to data considered to be relevant to them.

Considering a technical-oriented approach towards the interpretation of Blockchain, Blockchain is referred to a database that is composed of “chronologically arranged bundles of transactions known as blocks” (Wessel, 2016). Each block holds data about certain number of transactions, reference to the previous block in the chain and solution to a convoluted mathematical algorithm, which is used to “validate the data associated with that block” (Bonneau et al., 2015). In order to assure the legitimacy of transactions before recorded into a blockchain, the network confirms and gives approval upon the validity of the transactions. Afterwards, consensus is achieved by the computers in the network through voting mechanism according to the transaction validity and a new block of data will be formed and attached at the end of the blockchain as the most current block. (Franco, 2014; Bonneau et al, 2015)

Fundamentally, Blockchain technology is utilized to verify and record transactions via the implementation of a distributed and decentralized ledger. Through a peer-to-peer network of computers, the technology enables users to “send, receive and record value or information” (Kakavand and Kost De Sevres, 2017).

By way of joining the application of “peer-to-peer networks, cryptographic algorithms, distributed data storage and decentralized consensus mechanisms”, Blockchain technology is claimed to propose a solution in which people are able to agree on certain “state of affairs” and record “that agreement” securely and transparently (Wright and Primavera, 2015). Moreover, Blockchain is considered a “trust layer” that can act as a medium for exchanges with set of decentralized capabilities in its operation (Mougavar and Buterin, 2016). Wright and Primavera (2015), in their study, simultaneously content that Blockchain technology exemplifies revolutionary transformation for the “peer-to-peer economy”.

b) Characteristics of Blockchain

According to Zheng et al. (2018) blockchain has the following key characteristics.

• Decentralization: In an ordinary centralized transaction processing system, each transaction must be authorized by a central credible institution, which is the central bank. This process of authorization inevitably leads to an increase in cost and decrease in performance of the central servers. On the other hand, on the blockchain network, any transaction can be passed from one address to another without the

approval from the centralized institution. Thus, this means that server costs and performance slowdown can be greatly alleviated by utilizing blockchain technology.

• Perseverance: In the blockchain network, each transaction must be validated and then recorded in blocks that will be distributed across the entire network. Thus, it is nearly impossible to tamper the transaction. Moreover, each transmitted block will also need to be confirmed by other nodes, which also check the validity of all transactions in that block. Therefore, it is easy for the blockchain system to detect any malicious activities.

• Secrecy: Any user can make exchanges in the blockchain using a randomly generated address or identifier. Additionally, blockchain address can be freely generated without any limits. It is easy for user to possess multiples addresses to avoid identity leakage. There is no centralized agency that keeps track of all users' private data. This system ensures a certain degree of privacy for each transaction conducted in the network. However, even though the identity of each address is anonymous, all transaction information, which includes timestamps and values, is publicly visible on the blockchain explorer. Thus, the perfect privacy cannot be achieved using the blockchain network.

• Auditability: As all transactions on the blockchain network are logged with a timestamp, all users can trace back the past records by exploring nodes in the network. This will improve the overall auditability of the data through increased traceability and transparency.

c) Permissioned and Permissionless Blockchains

In a permission-less blockchain network, everyone can practically use the service and every service user's identity is anonymous. In this case, the only trust that users need for blockchain is that it, to a certain depth, is immutable. There needs to be a measure to mitigate this absence of trust. In a permission-less blockchain, every transaction cost a small fee to provide economic initiative to compensate for the cost of participating in a form of fault-tolerant computer system that based on "proof of work".

Permissioned blockchain network, however, has a group of trusted, known and often thoroughly inspected participants that works under supervision and administration to serve as a trust agency. With this specific and transparent trusted group, a permissioned blockchain network ensures the safety of interactions among a group of peers that have a mutual aim but may not have full trust in one another. In other word, the network can function properly, while participants may not fully trust one another, under a governance system that is depended on the mutual trust among participants, such as legal agreement or common framework for tackling disputes (Cachin, 2016).

d) Hyperledger Fabric

Cachin (2016) defined Hyperledger Fabric as a joint contribution of multiple stakeholders in order to produce an enterprise-level, open-source distributed ledger platform. The platform features include ability to run smart contracts, to combine proven, existing and reliable technology with a modular architecture allowing direct implementation of multiple functions. It promises to deliver a high level of privacy, resiliency, elasticity and scalability.

The Hyperledger Fabric is also a permissioned blockchain platform, which means that participants are identified to one another, unlike in a permission-less network, where all participants are anonymous with absence of trust. The standout feature of this platform is in flexibility in customizing with suitable protocols to perfectly tailored to the needs and trust models of the system.

Androulaki (2018) mentioned that Hyperledger Fabric is currently utilized in more than 400 prototypes, proof-of-concept and distributed-ledger systems in development, across multiple industries and use cases. Areas that Hyperledger Fabric is implemented are, but not limited to, disagreement resolution, business logistics and supply chain, foreign exchange network, food safety, contract administration, diamond origin, royalty point administration, low liquidity securities trading and clearance, identity management and agreement using digital currency. Another advantage of Fabric, as a highly customizable and expandable multi-purpose permissioned blockchain network, is that it supports the implementation of distributed ap-

plications that are written in standard programming languages. This means that Hyperledger Fabric can be considered the first distributed operating system for permissioned blockchains.

### 2.3.2 Applications of Blockchain Technology in field of Traceability and Transparency

According to Mearian (2018), along with paper legal documents, electronic data interchange, a technology that has existed for 60 years, is still the main information transmitter of the international shipping industry. However, when shipping industry migrates to API-based technology on newer platform, shippers, senders, receivers and everyone who is a part of the supply chain will have access to timelier and more transparent information. Producers want to make sure that their products will arrive at their chosen destination while consumers want to ensure the product comes from a reliable and trusted source. By considering both ends of the supply chain, it directly adresses the danger of fake goods, scam and robbery.

Mearian also suggested that Blockchain technology, either permission-less or permissioned network, directly tackles the supply chain challenge by being a fixed or unchangeable bookkeeper shared freely and openly among all network participants in real time. With distributed ledgers, both producers and retailers can minimize steps needed in the shipping and payment settlement process by observing the exact same information, regarding both physical and digital products in the supply chain. Another benefit that blockchain provides is economic liquidity enhancement. For instance, a combined agreement between producers or distributors and buyers can also involve financial middlemen, who will issue payments on invoices when all parties' agreed products have been delivered and conditions have been fulfilled. The earlier both involved parties can make an agreement on fulfilments and payments, the earlier producer can be paid for their products. Faster overall process including payment will lead to improvement in financial liquidity for the involved stakeholders of the supply chain.

Another big problem within supply chain management is mirroring. Mirroring happens when physical or digital documents such as bill of lading or invoices are, at the

same time, in possession of all stakeholders – shippers, producers, customers and others - involved in the supply chain. This repetition of documentation before the final settlement creates abundant inventory in the seller's systems, including receipts for purchasers, proof of delivery, invoices, payment and payment validations.

Francis (2018) proposed that there are about 5,000 firms, with over $1 billion in annual revenue each, that are performing transactions worth between $100,000 and $200,000 per minute. It is obviously a complicated process of tracking all those inventories and transactions' records and documents, including purchases, invoices, shipments, serial numbers and receipts, which are mutually and infinitely replicated among all the companies in the supply chain system.

With blockchain as the digital middlemen among trading parties, the buyer only needs to send the supplier its real level of inventory consumption which is compared with an agreed service level. Then, the supplier ships goods and sends invoices according to the buyer's input, and the buyer simply pays and periodically records amount of inventory to reconcile. Blockchain really helps simplify the whole process by having only one authorized set of data moving through one distributed ledger. The efficiency and productivity of inventory management will, thus, be improved because there is no duplication in records and documents in these back-to-back transactions.

Another crucial feature of blockchain technology is its native support for the execution of smart contracts. Smart contract can be defined as an automated digital contract with which terms and conditions are pre-defined and determined to each new data entry before the contract is recorded permanently on the distributed ledger (Merian 2018).

When a new data entry is recorded into the smart contract, the public record-keeping system automatically examines if all conditions for the pre-defined agreement are met to prevent out-of-balance situation. In the case that out-ot-balance happens, the system immediately prevents the record to be proceeded. Smart contracts will help accommodate trusted and transparent transactions among anonymous parties without the interception of a central trust agency.

For instance, when a company tries to add an invoice, it will be checked automatically through smart contract to make sure it matches all pre-defined conditions, prior orders, shipments and proof of delivery. If all tests are passed, the invoice then can be recorded on the blockchain network and it must be paid.

In the case that the invoice written is a duplicate, the smart contract and blockchain will compare all aspects of the contract, including open purchase orders, contract terms, existing invoices and payments, and if it doesn't offset, the record is rejected and will not be added to the blockchain.

### 2.3.3 Traditional governance of record vs. Blockchain-based governance of record

Cohn (2017) stated that in the current business environment, the business network is majorly consisted of multi-parties (described in Figure 9) including the producers, the finances, the regulatory, warehousing, transporters, retailers, in which each of party utilizes various method of maintaining record through its distinguished, internal ERP system. Most of the information is kept in silos with limited interoperability (Provenance, 2015). . Therefore, it is considered challenging to gain a full view over the entire supply chain ecosystem. As a matter of fact, whenever there is a movement created within that network, each member has a different vision of the current status and disagreement is unavoidable in the circumstance as such. There exists certain amount of frictions during the operation since the information often flows through traditional, unintegrated means of communication, for example text messages, e-mails or even paper documents (Cohn, 2017). Cohn (2017) mentioned that this implementation is inefficient, costly and definitely vulnerable because the data recorded in the system is vulnerable to alteration. *He* claimed that anyone who is authorized to gain access to the recorded information has the ability to edit it and therefore, this fact creates a layer of fragility to fraud.

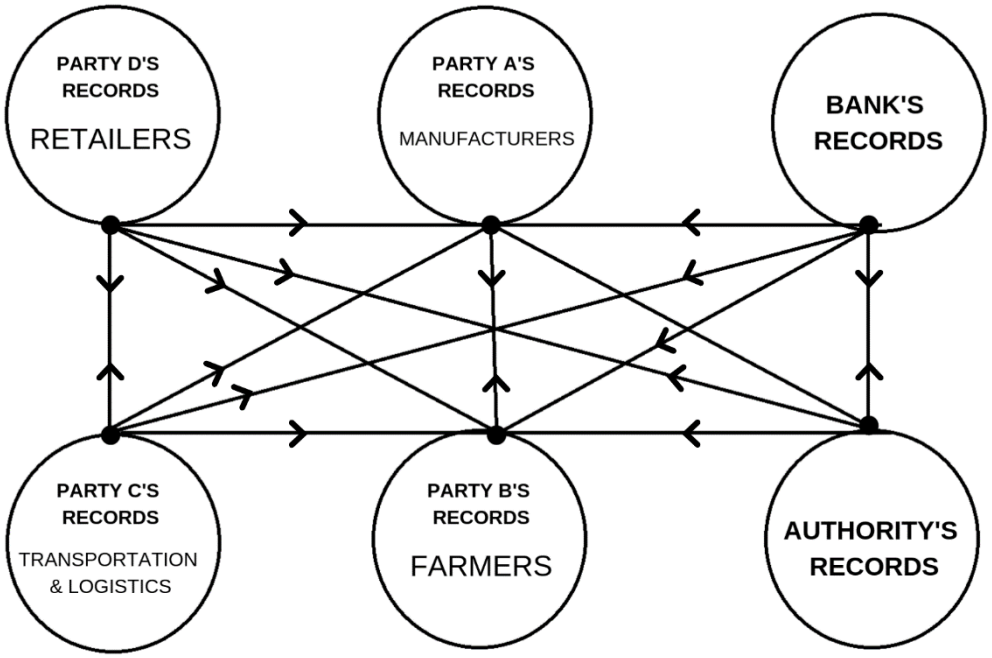


*Figure 14. Current business network (Cohn, 2017)*

The data governance system based on the development of Blockchain technology, on the other hand, is a single database in which every permissioned member within the chain has an identical copy of the recorded data. In the same trade cycle as illustrated in the Figure 9, the trade cycle in Figure 10 is slightly dissimilar. Every party within this cycle (Figure 10) agrees to be a part in the same consortium of the permissioned chain and each of which has the visibility to all recorded data where it is authorized and permissioned to gain access. This function granted involved participants the ability to see the location of their shipments, the conditions or the status of their commodities. Every member must give the consensus to the status of thing and the information consent is distributed throughout the network, hence, the risk of disputes or disagreement is minimized in this manner. The blockchain-based ledger technology is permanent and unalterable.

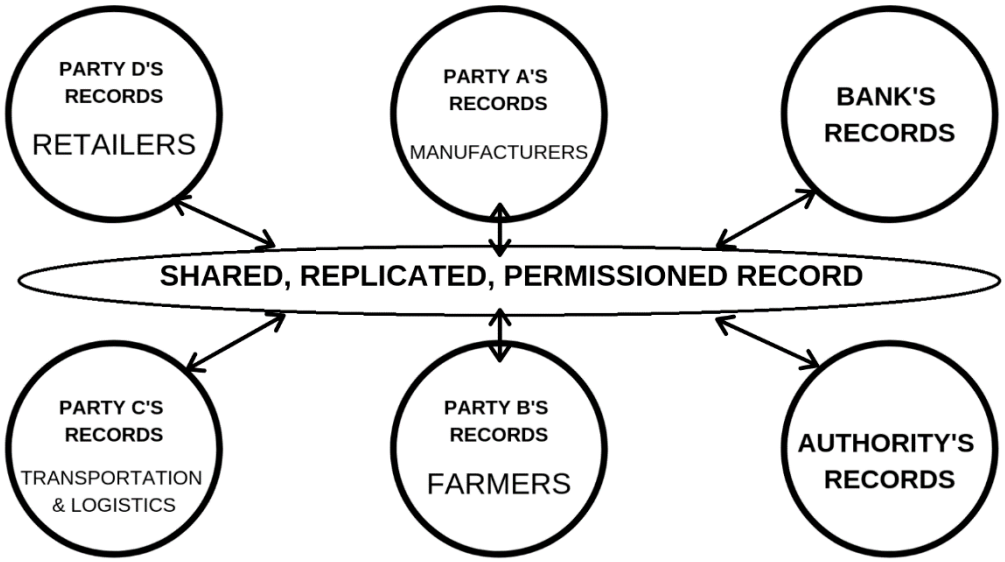


*Figure 15. Blockchain rings (Cohn, 2017)*

# 3 RESEARCH ENVIRONMENT

This section describes the research environment, where the author based and conducted her research. There will be two subsections for Research Environment, which formerly will focus on the market situation for Food & Beverage industry in Finland and the Finnish customer's behavior and awareness and latterly will introduce in brief the background of two companies taken into the study.

## 3.1 Finnish Food & Beverage Industry

Finland is geographically located in Northern Europe, bordering Norway to the North, Sweden to the North-West and Russia to the East, with its capital city is Helsinki in Uusimaa province. The total population of Finland is approximately 5.52 million habitats in 2018 with the total area is 338,424 km2. Finland is ranked as the third, among other most sparsely populated countries in the world, with approximately 17 inhabitants per square kilometer. Despite its sparse population, Finland is well-known worldwide for its effective welfare system and policy, which contributes greatly to the assurance of high living standard. Besides, Finland is benefited from the free movement of goods and labors as a member state of the European Union. The most recent statistic for Finland's Gross Domestic Product per capita was recorded in 2017, amounted at US$47057.62, which is equivalent to 373 percent of the world's average. The statistic reaffirms Finland's high developed status.

In comparison to other agricultural nations around the world, Finland possesses the northernmost agriculture due to its location and produces food from its pristine source of natural supply, including wild forests, lakes and so on. Finnish food is claimed to be the purest food in Europe, with efficient food safety control system. The use of pesticides is strictly limited in Finland because of the stringent food safety standards imposed by the Finnish government.

According to the statistics provided by Statista about the Food & Beverage industry of Finland, the revenue of this segment reaches to US$171m in 2018, with an expected annual growth rate of 13.1% (Compound Annual Growth Rate from the period 2018-2022) from a projected market volume of US$280m by 2022. Further, the

average revenue per user for Food & Beverages industry, which indicates the measure of revenue generated per user in the sector, currently amounts to US$339.26. The figures introduced, positively indicate the high consumption rate of Finland in the subjected industry.

### 3.2 Walmart and Atria

Walmart, a retail group in U.S.A and Kesko Group, a retail group in Finland will be considered as the target of this research.

Walmart is an International retail corporation founded in America in which operates a chain of hypermarkets, discount department stores, and grocery stores. According to a statistic collected at the end of January 2018, Walmart has 11,718 stores and clubs in 28 countries, operating under 59 different names with its fiscal year 2018 revenue of $500.3 billion, Walmart employs approximately 2.3 million associates worldwide.

Atria is a large-size, Finnish food company, located in Seinäjoki. The company operates on a global scale and is divided into 4 different business areas which are Atria Finland, Atria Scandinavia, Atria Russia, and Atria Baltic. Atria categorizes groups of customers into three major fields which are Consumer Goods Retailers, Food Service customers, and the Food Industry. According to its annual report 2017, the Group's net sales exceeded 1.43 billion EUR, and it employed an average of 4,449 personnel, estimated in the same fiscal year. In this research, we will primarily focus on the meat product lines marketed directly to the end-consumers (consumer goods retailers) of Atria Finland.

Walmart has already taken IBM Food Trust™ into their practice and the project has already evolved from only pilot project to production phase, with 19 lines of product and millions of food packages are now being traced through the use of blockchain technology. Therefore, gaining insights from Walmart’s executives on the pros and cons of this technology is helpful and practical to build up any in-depth recommendations for any other companies which are highly interested in the field.

In fact, Atria has already established its own in-house tracing system that allows customers to track the meat and poultry products on shelf to its provenance. The company always thrives its reach to novel, disruptive innovation and Blockchain lies within their field of interest for future adoption. Having any consultations or recommendations directly from outcomes achieved on the study with Walmart is believed to be beneficial for the Atria.

# 4 EMPIRICAL RESEARCH

The content of this section will surround the process of research designs, inter-views and results drawn from the proposed case study. The author will address about the outcomes of the research and recommend some viable suggestion for further studies.

## 4.1 Research Process

So that to collect in-depth and wide-view information about the traceability and transparency aspects in the operation of Food Supply Chain management, the author conducted semi-structured interviews, in which these interviews consisted of a default set of questions prepared in advances and open discussions between interviewer and interviewees which allow novel ideas to be brought up during the interview process. The set of questions contains three main parts:

Part I is the Introductory session, which includes questions regarding General Information. The author asked the interviewees to introduce about themselves, their career background (profession) and the company which they are currently working for.

Part II addresses the Supply Chain model and scale of operation of that particular company to see whether the company is operating internationally or domestically. The interviewees are asked to describe their supply chain model and their product tracing system. Furthermore, they are asked to evaluate risks and possible risk mitigation methods used for the Food Supply Chain Management.

Part III involves the list of questions which concern the traceability and transparency in the overall Food Supply Chain. Primarily, the interviewees are requested to voice their opinions about the importance of traceability and transparency as well as the benefits of leveraging traceability and transparency in both corporate and customer level. Afterward, they are questioned that whether their customers or other involved stakeholders have insights over the product's provenance and their supply chain network, respectively. The interviewees are then, requested to provide information

on how do they and what have they done to enhance the traceability and transparency of the chain in general and the effectiveness of those mentioned practices.

- For Walmart representative, he will be asked to evaluate the effectiveness and efficiency of Blockchain Technology, after being integrated into their Food Supply Chain management system. What are the advantages and challenges observed after the pilot projects? Are there any useful advice or recommendations for other companies which are planning to integrate Blockchain technology into their management system?

- For Atria representative, she will be asked to evaluate the effectiveness and efficiency of Atria's own in-house tracing system (this system is developed without the involvement of Blockchain technology). What are the pros and cons of this technology? Are there any rooms for improvements? Furthermore, the interviewee is also asked to give her perspectives on the integration of Blockchain Technology into Atria's Food Supply Chain Management system.

Based on the theoretical framework constructed, the author has assembled a frame of focused questions strictly regarding the transparency and traceability which go hand-in-hand with the management of Food Supply Chain. The objectives of conducting this interview are to visualize a grand commercial picture by gaining the fundamental understanding on company's supply chain system and the network of stakeholders, their views over issues in relation to traceability and transparency around FSCM and their perspectives on innovation management and applying disruptive innovation into existing operational system.

Orientation:

- How do you position your company in the current market?

- Does your company operate on International scale or only domestic?

- How well do you familiarize yourself with your company's supply chain management?

- How do you define/ Can you describe your company's supply chain model? (For e.g: "Is your supplier equivalent to the original source?"; "Are your customers the end-users?", etc.)

Risk Management:

- Regarding Supply Chain Management, which factors can be considered your most concerned risks?
- Can you describe your "recall procedures" when there is an event of food scare occurs? Specify the time duration of the procedure.

Traceability and Transparency:

- How do you evaluate the importance of transparency in the management of your supply chain? (Corporate level)
- Do traceability and transparency act as an essential role in satisfying the demand for customer satisfaction and operational cost savings? (Consumer level)
- Can your customer trace your end-products back to their original source? If yes, how do they trace it? Their experience?
- Are all the phases/stages in your existing supply chain accessible & auditable by involved members (both suppliers & customers) in your supply chain network?

For Walmart:

- How do you evaluate the effectiveness and the efficiency of integrating Blockchain technology into your Food Supply Chain Management system? What are the most prominent benefits observed while using the technology?
- Can you specify the pros and cons of the integration? Any possible solutions to tackle the current challenges, if any?

- From your experience, do you think that Blockchain Technology is contributing to the mitigation of the company's operational risks?

- What are your recommendations for other companies which are planning to implement the integration of Blockchain Technology into their SCM system or performing researches on the given subject?

For Atria:

- How do you evaluate the effectiveness and efficiency of your current in-house meat and poultry tracing system?

- Can you specify the pros and cons of technology in general? Any possible solutions to tackle current challenges, if any?

- Is it possible to enhance the scalability of the tracing system or it is only available for short value chain model?

- What are your opinions on integrating Blockchain Technology into your tracing system? Do you think Blockchain Technology is able to optimize your tracking model or mitigate the risks that your company is encountering?

The author initiated contact with Vice President of Food Safety Division of Walmart, Mr. Frank Yiannas and conducted a Skype interview with the Senior Director of Food Safety Division of Walmart, Inc. – Mr. Tejas Bhatt. Mr. Tejas Bhatt is the team leader, who is responsible for the operation of the entire project of integrating Blockchain technology on Walmart's Food Supply Chain system. His position and professional experiences in the field of Food Safety enable him to acquire knowledge on overall supply chain ecosystem of Walmart and the strict standard requirement for inspecting and evaluating food quality.

On the Finnish counterpart, the author has had also a remote meeting via video conference with Mrs. Anna Kultalahti, who is now holding the position as Product Group Manager at Atria Suomi Oyj. She is responsible for managing the pork and beef product lines supplied to Finnish retailers and international export activities related to this product line (if the field of operation is end-consumer oriented). Further-

more, Mrs. Kultalahti handles all tasks associated with strategic planning and implementation, development, and management of product group as well as for analyzing markets at Atria; her targeted area for management is end-consumer. She has been working at Atria for over 7 years. After the established conversation, the author was referred to another key role executive at Atria, Mr. Antti Laukkonen. Mr. Laukkonen has been the Development Manager at Atria for over 5 consecutive years, however, his actual time accompanying with Atria is nearly 10 years in total. Mr. Laukkonen has been involved in different production departments as a production supervisor and production manager. Five years ago, when Mr. Laukkonen was a Production Manager at Atria, his duties were to manage the beef and pork production operation to the end-consumer and HoReCa market. For the time being, he is responsible for the operation of Atria's strategic production development program that aims for quality, efficiency, and productivity. Moreover, his current tasks as development manager involve enabling the use of digital information within the production and supply chain for different management levels and purposes. All in all, provided exceptional competence in the field of production and product management associated with the advance knowledge over Atria's operation, Mrs. Kultalahti, and Mr. Laukkonen are both familiar with Atria's production and supply chain activities in Finnish markets and possess high-level expertise as well as invaluable insights into Atria's supply chain network, that can strongly validify the conduct of research and support the cause of this thesis.

## 4.2 Case study

This particular subsection will introduce the two case study companies, which are Walmart, Inc., an American international retail corporation and Atria Oyj, a Finnish food company.

### 4.2.1 Walmart's Mango Tracking Journey from Mexico (in cooperation with IBM Food Trust™)

Walmart, a retail group in U.S.A and Kesko Group, a retail group in Finland will be considered as the target of this research.

Walmart is an International retail corporation founded in America in which operates a chain of hypermarkets, discount department stores, and grocery stores. According to a statistic collected at the end of January 2018, Walmart has 11,718 stores and clubs in 28 countries, operating under 59 different names with its fiscal year 2018 revenue of $500.3 billion, Walmart employs approximately 2.3 million associates worldwide.

a) <u>The growing process of Mango Product</u>

Described by Mr. Frank Yiannas in one of the summits organized by IBM in 2017 on the subject about Blockchain and Food Safety, the process of delivering the mango from farm-to-fork is visualized in the following diagram which created by the author:

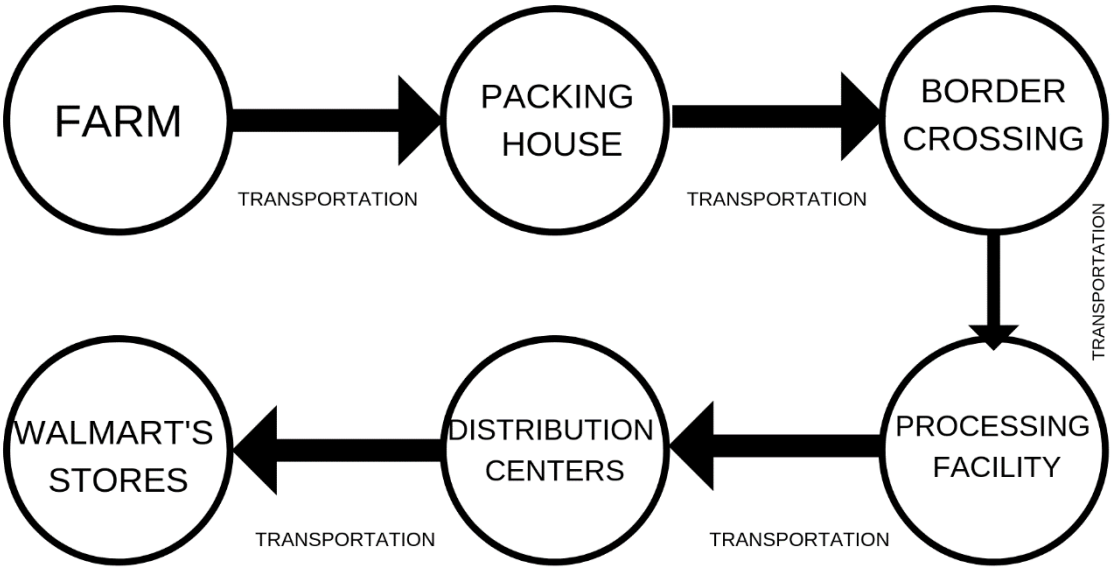


*Figure 16. The supply chain of Mango slice product at Walmart*

The first stage of the process is seedling, where the mango seeds are first planted in the soil at the farm. It generally takes from 5 to 8 years for the mango tree to reach its full maturity and bear fruits under intensive care of the farmers along with other factors that aid the growth of the mango trees, including the monitoring of appropriate soil and weather conditions, fertilization, irrigation and so on. At the right period of time, when the trees come of mature age and fruits are ready to be collected, the mangoes will be harvested just before they are fully ripened since, after the gathering, these mangoes will continue to ripen in approximately one to two more weeks. For Walmart, the mangoes are grown by small-scale farmers in America's hemisphere, either in Central or South America.

Afterward, these fresh mangoes will be transported to a packing facility and get their first washes at the facility. Further transportation is carried by air, land or sea freight. Moving on to the next stage, the mangoes cross the U.S custom border for the entrance to the United States where the processing facility is located. In this processing stage, those mangoes are further washed, peeled, sliced into smaller pieces and placed in separate packages. From those packages, the mangoes are shipped to Walmart's distribution centers located across the country, where they are refrigerated and later on, showcased on the shelves at Walmart's stores as the final point of purchase for consumers.

b) Pilot project

The pilot project of tracing mango products in the United States which was originally sourced from Mexico carried out by Walmart in collaboration with IBM, using the platform IBM Food TrustTM, has been successfully implemented. As an introduction to the concerns of traceability and transparency in the Food Supply Chain, Mr. Tejas Bhatt pointed out that before the integration of IBM Food TrustTM was executed, it would take generally days, if not weeks in order to trace back the entire journey of that single mango slices product from Mexico all the way to the United States, which is inefficient, time-consuming and bears a great economic burden to the recalling procedures. However, now, with the assistance of IBM Food TrustTM, Walmart can perform that traceability in minutes, or even seconds. The application of technology allows full traceability of the mango slices from original suppliers to retailers and ultimately, to consumers. The essential information for quality assurance process

and logistics such as farm origination details, batch numbers, hosted facilities, processing data, expiration dates and shipping details are digitally linked to the specific food items via smart devices in every farmer's hand and recorded into the platform at each stage of farm-to-fork process. Each node in the blockchain, which is the computer, maintains a copy if a ledger of every transaction. Whenever a transaction takes place, 2 nodes at minimum, must give consent to it or in simpler term, approve it so that the transaction is added to the ledger. The database provided by blockchain is auditable, transparent and unalterable. In addition, all captured information is distributed across the chain and along that flow, even the customers are involved. The customers are enabled to scan the code attached within the product label to gain the complete view of the product origin, how it was handled, how it was produced and grown as well as other attributes. These attributes will be customized according to the interest of the customers. By doing this way, the executives of Walmart believe that the consumers will be secured and empowered with knowledge of the food chain and putting more trust forward the products they are using. According to Mr. Bhatt, the goal of this project is not only to advance traceability but also to ensure and ameliorate the aspect beyond traceability, which is transparency.

### 4.2.2 Atria's Meat Tracking Journey

Atria is a food producer that operates within the Baltic region (Finland, Sweden, Denmark, Russia, and Estonia), based in Seinäjoki, Finland. The company has an extended history of operation that has lasted over 110 years and it is currently ranked among the leading food companies in Nordic countries, Russia and the Baltic region, with Group's net sales exceed EUR 1.43 billion in 2017 (according to Atria's Annual Report 2017). Atria categorizes its groups of customers into three main areas which are consumer goods retailers, food service customers, and the food industry. As its business operations are spread over 4 major areas, which can be listed in a descending order as follow: Atria Finland, Atria Sweden, Atria Russia, and Atria Estonia & Denmark, the Group has participated in large-scale export activities that involve heavy international trades in which Atria exports its products for cus-

tomers abroad. Its export business includes customers in Europe and Asia and varies according to the market balance. Export business involves customer-specific products and specifications that the company needs to take into consideration throughout the supply chain.

The meat and poultry supply chain in Finland involves the production chain from the farms breeding livestock up to slaughter and food production. Atria’s meat chain includes beef, pork and poultry, and the company also produces fresh meat, cooked meat and convenience food products for retail, dealers and HoReCa sector (Hotels, Restaurant, Cafeteria). In Finland, Atria has a conjoint transport company cooperating with a few other Finnish food producers for the purpose of transportation.

As declared in Atria's main webpage, traceability in meat products is a key competitive advantage for Atria as those meat products including pork, beef, chicken and turkey are sourced from a Finnish farm to ensure the set of quality standard of Atria. Meat products are tagged with Family Farm label in order to illustrate the origin of the product back to its farm. The label empowers end-consumers with necessary information about the products and indicates the provenance where the cattle were raised to ensure the high maintenance of animal welfare and the production conditions at the production site. The entire tracking process is developed and carried out in the cooperation between Atria and meat producers. The first Family Farm chicken products with farm-specific labels were first proposed to the public in 2012 to enhance the traceability in production and improve the transparency of the chain in overall. It is claimed by Atria that traceability guarantees safety since any issues which threaten the food safety will be prevented and consumer awareness in the event of food scares will be secured.

The simplified supply chain model for meat and poultry product lines of Atria is visualized according to the figure 13 illustrated below

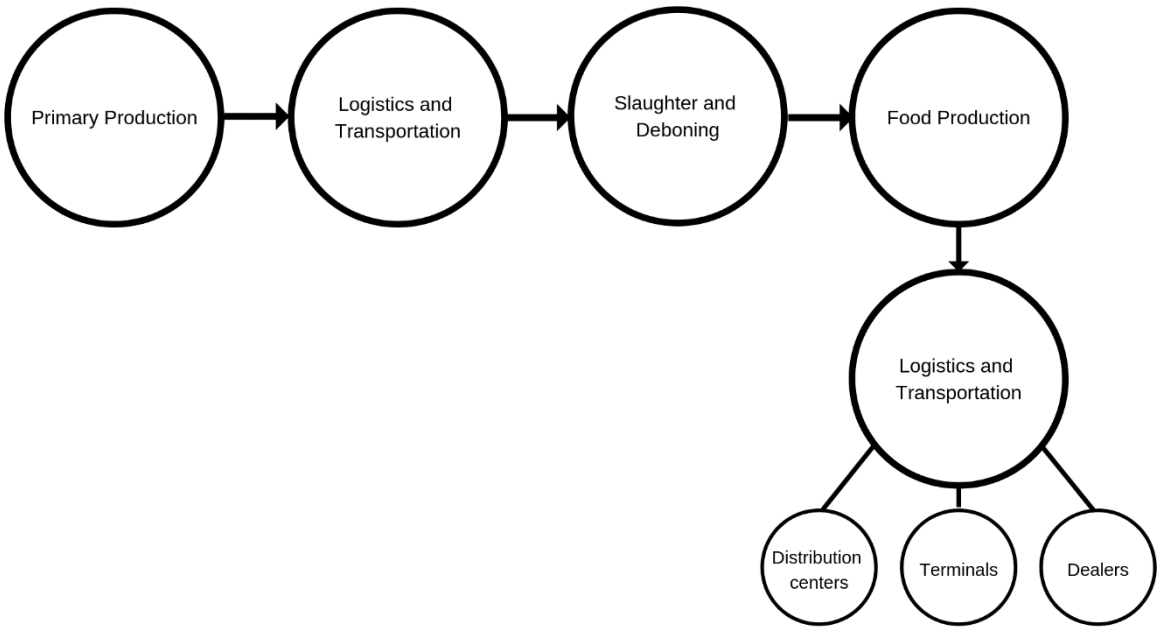


*Figure 17. Simplified Supply Chain model of Atria's Meat and Poultry product lines*

First, the livestock at farming sites will go through the primary production activities, including livestock breeding and farming, which are performed by farmers before being carried to the slaughterhouse via the transportation services provided by Atria's conjoint transportation partner, called Tuoretie Oy. The livestock then is slaughtered and deboned at the production facility ran by Atria. After this stage, the meat will be undergone the process of food production according to the distinguished customization and specification in order to suit the requirements and the needs of demanded markets. Later on, the processed meat products will be distributed to different distribution centers, terminals and network of dealership to carry on the products to the final point of consumption.

The farms that are owned by farmers are responsible for the involved primary production. Atria as a company owns and runs the production and logistics. Transportation activities are managed by the conjoint company (Tuoretie Oy) as mentioned above.

### 4.2.3 Benchmarking

a) Scale of operation

*For Walmart*, the product line taken into the trial (Mango slices product) involves cross-border trading and sourcing from Mexico then being processed, distributed and consumed in the US market. The operation takes into account partners from different countries with trading and logistics activities occur also outside the US border. Therefore, the scale of operation from Walmart's perspective is international with long food miles. The blockchain platform enables Walmart to have a full control over the supply chain network, as all involved stakeholders must provide adequate information including prerequisite documents, certifications for export and import operations and product quality assurance, and current status and conditions of the product at every phase, in which the products are handled for real-time update to the entire chain.

*For Atria,* Mr. Laukkonen claimed that the tracking systems operate only within the local premises and tracing is done in cooperation with the local organizations. Therefore, the tracing process is only applicable in the Finnish market and domestic consumers, without the involvement of any partners overseas or any activity of international procurement. Due to this characteristic, the food mile in the case of Atria can be evaluated as considerably short. For such products flow through the domestic market, it is believed be easier for Atria to have a grasp of the real-time update for the flow of every product because of the minimal number of involved, trusted stakeholders within the chain.

b) Recalling procedures

*For Walmart*, the recalling procedures for food products at Walmart in prior to the adaptation of Blockchain-based platform will generally take several days to accomplish due to the inherent complexity of the food supply chain network, even applied to a single food item. The recalling procedures will follow the industry guidelines instructed and published by the FDA.

In case of recall, the firm will have to

- Draw recall submission to the FDA, including the detailed product information, codes (production identification numbers), detailed information of recalling firms, manufacturers, reason for recalls, health hazard assessment, volume of recalled product(s), distribution pattern and recall strategy.

- Publish public notification and instructions to customers.

- Report the evaluation of the recall including the effectiveness of the recall, recall status report, the root cause of the issues that resulted in the recall, corrective actions in order to prevent future occurrences of the issue, and finally, the termination of the recall.

*For Atria*, the traceability is majorly based on production and handling batches. The concept and data content of batch varies in different parts of the supply chain, but the recall procedure is based on this batch structure.

In case of recall, Atria will

- Identify the batch where the anomaly has occurred

- Notify and instruct the stakeholders that have received the products that originate from the located batch

- Prevent further damages according to risk assessment

This is all done within a time span of a few hours, which is relatively short. During this course, Atria also performs a wide-scale investigation on how the anomaly has occurred to control this risk from there on.

c) Tracing systems

*For Walmart*, the tracing system is based on the identification of batch information, specific lots, pallets, serial numbers or date of expiration depending on how the product is packed and recorded along the supply chain. Walmart is currently utilizing IBM Food Trust™ as a tool for tracing and management of the Food supply chain. Because of the nature of the Blockchain technology, the data entered into the system are encrypted by cryptography which ensures that these data are permanent, securely stored, tamper-proof and persistent. Furthermore, the copy of data stored

in the system is distributed to every permissioned network member within the chain which allows flexible access to the users and enhance the transparency along the chain.

*For Atria*, the tracing system is also based on batch concept as depicted earlier. The use of blockchain technology for data storing and information distribution is not utilized in Atria's operations as the existing, in-house technology has already provided effective means to respond to the current needs of traceability and transparency. In fact, Atria's tracking data is built into the operational systems which are an integral part of the floor level operations and is thus tamper-proof.

### 4.3 Results and recommendations

To begin with, the empirical study has identified some differences between the tracing systems, the scale of operation, supply chain model of the two product lines taken into the study, including mango slices sourced from Mexico of Walmart and meat & poultry products sourced locally of Atria and the recalling procedures and fundamentally, the two subjected tracing systems.

The supply chain model for the mango product of Walmart is to some degree, more sophisticated than the supply chain model for meat and poultry products of Atria in Finnish market because that of Walmart involves cross-border handling (from Mexico) meanwhile the meat products from Atria mainly sources from local farms.

Walmart's tracing platform, IBM Food Trust™, utilizing the technology of Blockchain shown advancement in its operation as it provides a broad view over the totality of the supply chain ecosystem. The duration of the recalling process performed by Walmart in prior to the integration of Blockchain was time-consuming due to the complexity of the supply chain network and the demanding protocol required by the authority. Nonetheless, the platform based on the use of Blockchain technology which is taken into use by Walmart has been claimed to successfully encounter the existed issues by the executives at Walmart since it significantly enhances the traceability, transparency and auditability along the chain. As a result, the recall that previously took several days to carry out now has been reduced to only a few minutes.

The consumers in US food market are also empowered with the knowledge of the entire journey of food products, were they ethically and organically produced, how were they handled and their physical conditions through all stages of production via a simple scan gesture on food product label.

On Finnish counterpart, Mr. Laukkonen emphasized that a tracking system is in many ways a fundamental requirement in food production, but Atria also sees that the need for transparency and consumer awareness and interest of the product origin is increasing. Thus, Atria is keeping itself aware of the market, consumers, customers and technology to be able to respond to the changes that occur. He further mentioned that blockchain is an interesting technological solution that provides possibilities for transparency and wide data distribution over organization limits. However, the solutions utilized are always business and customer case related, not only technology driven. Mr. Laukkonen believes that this is not only a data system solution but a process that actively involves people and the use of available information. This way of operating needs a close cooperation with stakeholders when it comes to the tracing of the whole supply chain. However, it will be tremendously beneficial for current tracking needs from both corporate and consumer level. In the short-term future, Atria needs to be able to combine more of the benefits of both process involvement and new technologies. Hence, the company will also conduct researches and studies on the possibilities of new technologies, including the consideration of integrating Blockchain technology to be able to respond to the upcoming needs. In addition to the argument provided by Mr. Laukkonen, Mrs. Kultalahti adds that when the trading activities need an upgrade to international scale that requires the involvement of new business partners at the other side of continent that can obstruct the management and control from Atria, then some obstructions that may challenge the operation will be at ease and the risks will be to some extent, mitigated if this form of technology can facilitate the ground of trust between two parties by providing accuracy and availability of essential information to verify data authenticity.

Learning from previous experiences of Walmart, the author suggests that Atria could initiate a pilot project on utilizing the Blockchain technology as a tool for tracing and managerial activities for a defined period of time in order to prove out the feasibility

of the project, shape the business model, better evaluate the efficiency of this technology and effectively gain more in-depth insights about Blockchain and other possible opportunities that the technology may bring to the interest of Atria. The company should primarily establish a Minimum Viable Ecosystem (MVE) apply to a Minimum Viable Product (MVP) so that the trial ecosystem remains simple for study and observation to see whether the technology fit to the Supply Chain management system before starting out to a more complex network. This phase can be done by starting with a single line of product and a selected, small group of trusted stakeholders (participants) excluding end-consumers to avoid unexpected complications and to help Atria to understand the core concerns across the network. It is crucial to thoroughly consider which partner should be taken into the project because, in the later phase of development, these participants will likely make a great impact on the future network. These participants are recommended to be those who are from Atria's existing business networks since these contacts have already had an existing relationship with the company and apparently, there are already processes in place for coordination. In setting up the MVE, it is important to determine the key sample segment that will shape the ecosystem. The sample segment in the case of Atria could be farmers, transportation company, and retailers. The precise figure for the number of participants in the MVE is not as important as the inclusion of key role segment will take part in the network.  As a matter of fact, the same network of operation usually involves direct competitors, therefore, planning out in detail strategies to encounter the pre-competitive challenges is necessary to effectively implement the project without any cross-contamination from the coopetition (the term used to indicate cooperation and competition). The MVE in this case of Atria should not be less than three mentioned stakeholders because lessen the number of participants may not enable Atria to get much-needed data input and feedback to establish the ecosystem with a shared value to all stakeholders, and it has a greater risk of creating disputes and split votes when making decisions. During the entire project, Atria's executives should keep track of the progress and record any improvements or drawbacks noticed while operating. When the trial period comes to expiration, this phase is extremely crucial for Atria to analyze recorded data, create reports, evaluate the entire pilot project in term of both cost-effectiveness and the efficiency when applied into the system itself. By doing this way, Atria will be able to

acquire concrete knowledge on the integration of Blockchain technology and pioneer Finnish food industry for early adoption of new technologies into operation apparatus.

# 5 CONCLUSION AND SUMMARY

In this section, the author will revisit the entire course of thesis writing and evaluate the usefulness of the recommendations, as well as the thesis's validity and reliability. What the author has learned and achieved, how she applied the theoretical foundation to practices in reality and what could have been improved throughout the whole thesis work will be reflected and discussed explicitly. Ultimately, this section will also hand out several different suggestions for future research/study.

## 5.1 Usefulness of the recommendations/ Study Result

After the study, the author realized that the food supply chain network, in reality, is highly sophisticated and often consists of numerous different actors ranging from farmers, food processors, transportation companies to distributors, retailers, and business customers, for example, those of retail sectors. In point of fact, every member within the chain has a distinguished way of archiving its data, tracking and keeping its system manageable. Most of them will record and track their activities as well as the food data manually, either on papers or on systems that do not speak to each other.  It is rather challenging to achieve a complete view of the totality of the Food Supply Chain.

The findings of the research interests Mrs. Anna Kultalahti and Mr. Antti Laukkonen. Mrs. Kultalahti mentioned that the meat traceability that is available to the consumers are only feasible in Finland since they only circulate and trade Finnish meat within Finland. This fact makes the meat supply chain within Finland less complicated and more controllable. However, she stated that other branches of Atria situated in different locations, including Atria Denmark, Atria Sweden and Atria Russia import meat from various sources internationally and there is no guarantee for traceability in these cases as that of Finland. When the author and Mrs. Anna Kultalahti were discussing on the subject of expanding Atria’s business to other international markets, we addressed also some aspects regarding to risk management, whether, without total traceability, when there is a food event occur, will Atria be the liable party if the perished meat products are originated from the brand? It is crucial to

determine the root of the problem: Whether it is the sub-standard original quality that was supervised, monitored and inspected by Atria or whether it is the malpractice and misconduct of standard procedures performed by other handling parties, for example, the retailers themselves or the carriers? She agreed that this could be a weak point when it comes to handling business at global scale and the trust between partners has not been well-established. By gaining a holistic view over the entire supply chain and utilizing the data from an immutable record so that one party can trace the activities of a product along its journey until the final point of consumption, the trust between stakeholders will be leveraged and the accuracy, as well as the availability of information needed for verification, would be improved notably.

In order to embed the Blockchain technology into Atria's operation, Atria would need to carry out further researches and evaluations in term of cost and efficiency to successfully adapt and integrate the technology. Mr. Antti Laukkonen is well-aware of the importance of traceability and transparency in both case of corporate and consumer level - a lesson he has learned from the decision-making process, the purchasing behaviors of consumers and the market. Such large companies like Atria have a huge influence on its operating sector and specifically, on the consumers' perception because of its extended course of operation and broad range of varieties offered in the markets which are consumed at gigantic quantity daily. Therefore, ensuring and maintaining the absolute traceability in hand with high-degree of transparency would assist to create an auditable, healthy food supply chain ecosystem which significantly reduce cost and increase efficiency for each and every member within the chain as well as empower consumers with knowledge and detailed insights of the food products that they have to consume on a daily basis.

## 5.2 Reliability

The interviews with the senior director at Food Safety division of Walmart and Product development manager and Development Manager of Atria were executed without obstructions or difficulties thanks to the active supports received from the two interviewees.

Since the collaboration project between IBM and Walmart is implemented from the top-level executives, including Mr. Tejas Bhatt, many useful insights and constructive recommendations to support the study are provided in great details. Even though many details of the Blockchain project carried out by Walmart and IBM are known by the author through her findings on research papers and publications that are widely published on the Internet, the interview solidifies and assures the reliability of information utilized by the author throughout her research.

The author collected data from Atria practices directly from the company's website as well as from both product development manager and development manager at Atria, therefore, those data presented in the thesis about Atria's operation are considered reliable.

However, there are certain limitations and drawbacks for the benchmarking of the data collections from Atria and Walmart because of the difference in operation scale of the two companies which might lead to incompatible or irrelevant comparisons between the two proposed meat tracking models.

Walmart focuses on the sourcing of food products on a global scale, which in our case study is the mango products from Mexico, that inherently bearing long travel distance from the origin of the product (where the food is grown) to the final point of purchased/consumed (where it is ultimately delivered to the hand of end-users). This journey involves numerous farmers, food producers, and shippers, is highly complex in nature and is absolutely difficult to keep track and audit on the production activities of every single member within the chain of this one particular product line. In actual fact, the operation itself bears a significantly high degree of risks. Therefore, the application on Blockchain technology is supposed to untie some knots of the complexity, enhance the transparency and improve the traceability of the chain as a whole through a tamper-proof, secured database, which contains the records of transactions, documentation and real-time data updates of all permissioned members.

Atria's meat and poultry tracing system, on the other hand, operates on a domestic scale, which involves only stakeholders, chain members within Finland. Thus, inspecting the production activities and managing the relationship between each

stakeholder would be more controllable and less complicated than that of Walmart. Due to this characteristic, Atria is likely to bear less unpredictable risks in term of quality assurance, transportation and is less vulnerable to the bottleneck and economic burden if any recalling procedures in the event of food scare occurs. As a matter of fact, Atria has a short value chain, which enables the company to ease the process of ensuring high-quality output delivered to the consumers. Hence, it can be noticed that utilizing Atria's own in-house tracking technology without the adoption of Blockchain technology in its system is already adequate.

The question here is, is the efficiency and effectiveness of the two, proposed tracking model comparable to one another due to its different scale of operation?

## 5.3 Validity

The thesis focuses on the study of the impact of Blockchain technology on Food supply chain management, in term of traceability and transparency, and introduces a case study from two large companies in which are using its own food tracing system, one with the assistance of Blockchain technology (Walmart) and the other operates on different technology assistance. However, as mentioned earlier, the limitations of knowledge to generalization of my research study is inevitable since the system model, implementation and the supply chain structure of two companies are incompatible to a certain degree. Therefore, this obstacle cast some doubts about the validity of the research:

- Are the two studied companies correspondent in the field of operation? Will the difference and incompatibility create imprecision when benchmarking the two systems?

- How valid is this study when generalizing to Food Supply Chain Management as a whole?

- Could this study be generalized to Food Supply Chains operated at both domestic and international scale?

Could it be applied to other industries, for example, clothing and textile or fast-moving consumer goods (FMCG) industries?

The subsection 2.1.3 and section 2.2 have addressed some common characteristics generally noticed in the supply chain structure and specifically in Food Supply Chain structure in association with the complexity of all forms of supply chain, such as the upstream and downstream activities, involved stakeholders - even though the number and the role of stakeholders in different types of supply chain will vary. However, as described in the Empirical Study, the Supply Chain model of Atria and Walmart for meat and mango products are deployed somewhat in a similar manner and comprehensible to other product lines in Food & Beverage industry. The integration of the tracing system based on the application of Blockchain Technology can be applied widely regardless of the scale of operation meaning that the company can either be participating in domestic or international trade. As denoted in subsection 2.2.4, the traceability and transparency are essential for any firms, both at corporate or consumer level. Moreover, the definition and possible applications denoted for Blockchain technology in this thesis directly focus on the area of Supply Chain Management and Logistics, universally. Hence, other studies in the entire Food & Beverage industry could still utilize provided information about the Blockchain technology, the adaptation of this technology to its Supply Chain and Logistics Management practices from this thesis.

The noteworthy points of this study lie in the benchmarking of the two tracing systems, one executed by Walmart and other by Atria, in which difference between the technology application, effectiveness in the enhancement of traceability and transparency, as well as the pros and cons of the two models have been brought out for analysis. Other companies in various industries which share identical characteristics as the two subjected companies and same interests of integrating Blockchain into their management system could utilize this study at its best. Or else, if there exist some uncertainties or contrary fashions in the method of implementation, variations in operation size, scale, financial capability and other socio-demographical and cultural dimensions should be considered thoroughly when applying the data demonstrated in the thesis.

## 5.4 Reflection

While working and carrying out numerous researches for this thesis, the author advanced her researching skills and critical thinking. Due to the massive workload in association with pressure on time, the author was able to manage her working schedule in a more strategic and efficient fashion.

Performing an extensive research over a thesis topic requires intensive reading from various source of information, including both academic materials as well as articles on the internet and social media. Working on this thesis can also be seen as a process of disciplined and in-depth self-study with modules and guidelines one created for herself in order to best match the skeleton of her thesis outline. Therefore, the author had an opportunity to delve into the area of Food Supply Chain management, to gain a better grasp over the big picture of the network in general and how it functions and how both tangible (commodity, final-products, documentation) and intangible (information) factors flow among involved stakeholders across the entire chain. In addition, the author enhanced her knowledge about one of the newest technology trends in the world which is now, bearing expectations to transform the way that many industries have been operating over an extended period of time as we know it, so-called Blockchain technology and its application to improve the practices of Food Supply Chain Management in term of traceability and transparency.

Several interviews conducted throughout the work, from experts in the related field of Food Supply Chain Management, the author was empowered to ossify her knowledge over the subject and assure the validity of her theoretical framework. Furthermore, being exposed to the real business world and experienced the professional and academic working manner are the practical lessons earned throughout the interview process. Over the course of writing this thesis, the author was encouraged and motivated to develop her interpersonal skills such as communicating, idea-pitching and to enhance her professional growth in term of business networking and career assessment.

## 5.5 Future Research

To begin with, Blockchain technology is immature to some extent and it is now still in its early phase of development. Therefore, there are numerous applications of this technology is yet to be discovered. Other researchers who are interested in the application of Blockchain technology can extend this study to other industries, other fields of business or other functions that may enhance further development of the business. Those emerging studies can enrich the data pool, strengthen or weaken this study.

As suggested by Mr. Tejas Bhatt, the application of Blockchain Technology on FSCM is still rather a new concept in the marketplace at the moment, however, it is being educated and acknowledged broadly by the general public. The room for adaptation is emerging at a fast pace, however, the existing difficulties are also manifold. "Interoperability in data when integrating Blockchain technology into management system" or "Collaborating the members of supply chain network using the shared platform based on the use of Blockchain Technology: Resolving pre-competitive challenges and Incentivizing the members" could be useful academic researches for investors interested in this niche.

Furthermore, current challenges noticed in Supply Chain management in general, remain in great number, for examples, visibility and data consolidation; tracking, transparency and trust or real-time issue resolution. Hence, any researches to study in-depth and resolve these challenges of Supply Chain is highly encouraged to fulfill.

This study can serve as the basis for other further studies aimed to focus on improving the traceability and transparency of FSCM utilizing novel type of technology. From this study, further researches about similar topic should be carried out consistently and taken into serious consideration in order to educate, raise the awareness about new trends of technology as well as the importance of traceability and transparency on the field of FSCM and prepare “future participants” (including farmers, processors, manufacturers, distributors, retailers” with proper understandings.

# BIBLIOGRAPHY


Androulaki, E., Barger. A., Bortnikov, V., Cachin, C., Christidis, K., De Caro, A., ..., Yellick, J. 2018. Hyperledger Fabric: A Distributed Operating System for Permissioned Blockchains [Online Publication]. [Ref. 04 November 2018]. Available at: https://arxiv.org/pdf/1801.10228v1.pdf

Antoniol, G., Canfora, G., Casazza, G., and De Lucia, A., 2001. Maintaining traceability links during object-oriented software evolution. [Online Publication]. Software: Practice and Experience. [Ref. 13 October 2018]. 31(4): p. 331-355. Available at: https://doi.org/10.1002/spe.374

Atria Plc. Undated. Atria Annual Report 2017. [Online Publication]. Atria Oyj. [Ref. 06 November 2018]. Available at: https://www.atria.fi/globalassets/atria-agroup/yritys/vuosikertomus-2017/atria-annual-report_financial-statement-2017-uusi.pdf

BBC News. 7 February 2013. Findus beef lasagne contained up to 100% horsemeat, FSA says. [Online Article]. BBC. [Ref. 23 October 2018]. Available at: https://www.bbc.com/news/uk-21375594

Beier, J. 2014. How Does Traceability Advance Sustainability in Global Supply Chains? [Online Article]. BSR Organization. [Ref. 21 October 2018]. Available at: https://www.bsr.org/en/our-insights/blog-view/how-does-traceability-advance-sustainability-in-global-supply-chains

Billington, C. and Lee, H.L. 1 October 1995. The evolution of supply chain management models and practice at Hewlett-Packard. [Online Article]. Journal. [Ref. 16 October 2018]. p. 42-63. Available at: https://doi.org/10.1287/inte.25.5.42

Bonneau, J., Miller, A., Clark, J., Narayaan, A., Kroll, J.A. and Felten, E. 2015. Research Perspective and Challenges for Bitcoin and Cryptocurrencies [Online Publication]. [Ref. 31 October 2018]. Available at: http://www.jbonneau.com/doc/BMCNKF15-IEEESP-bitcoin.pdf

Boström, M., Börjeson, N., Gilek, M., Jönsson, A. M. and Karlsson, M. 2012. Responsible procurement and complex product chains: The case of chemical risks in textiles. [Online Publication]. Journal of Environmental Planning and Management. [Ref. 12 October 2018]. 55(1), p. 95-111. Available at: https://doi.org/10.1080/09640568.2011.581885

Brakeville, S. and Perepa, B. 2018. Blockchain basics: Introduction to distributed ledgers [Online Article]. IBM Developer. [Ref. 31 October 2018]. Available at: https://developer.ibm.com/tutorials/cl-blockchain-basics-intro-bluemix-trs/

Bruckner, M., Fischer, G., Tramberend, S. and Giljum, S. 2015. Measuring telecouplings in the global land system: A review and comparative evaluation of land footprint accounting methods. [Online Article]. Ecological Economics, pp. 11-21, Available at: http://dx.doi.org/10.1016/j.ecolecon.2015.03.008

Business for Social Responsibility and United Nations Global Compact. 2014. A Guide to Traceability A Practical Approach to Advance Sustainability in Global Supply Chains. [Online Publication]. United Nations Global Compact. [Ref. 16 October 2018]. p.6-7. Available at: https://www.unglobalcompact.org/docs/issues_doc/supply_chain/Traceability/Guide_to_Traceability.pdf

Cachin, C. 2016. Architecture of the Hyperledger Blockchain Fabric. [Online Publication]. IBM Research – Zurich. [Ref. 12 November 2018]. Available at: https://pdfs.semanticscholar.org/f852/c5f3fe649f8a17ded391df0796677a59927f.pdf

Casco, J. 2015. Wine, Lies and Glycol - The Austrian Antifreeze Scandal [Online Article]. The Wine Stalker. [Ref. 22 October 2018]. Available at: http://www.thewinestalker.net/2015/04/austria.html

Centers for Disease Control and Prevention. 2006. Multistate Outbreak of E. coli O157:H7 Infections Linked to Fresh Spinach [Online Article]. Centers for Disease Control and Prevention. [Ref. 12 November 2018]. Available at: https://www.cdc.gov/ecoli/2006/spinach-10-2006.html

Chapman, J. July 1995. Transparency? What Transparency? Business Ethics: A European Review [Online Publication].[Ref. 12 October 2018]. 4(3), p.139-142. Available at: https://doi.org/10.1111/j.1467-8608.1995.tb00244.x

Christopher, M. 1998. Logistics and Supply Chain Management. 1st edition. Great Britain: Pearson Education Ltd.

Christopher, M. 2011. Logistics and Supply Chain Management. 4th edition. Great Britain: Pearson Education Ltd.

Cohn, J. and Yiannas, F., 2017, Genius of Things: Blockchain and Food Safety with IBM and Walmart, [Video]. [Ref. 12 November 2018]. Available at: https://www.youtube.com/watch?v=MMOF0G_2H0A

Connolly, J. and Prothero, A. March 2008. Green Consumption. [Online Publication]. Journal of Consumer Culture [Ref. 12 October 2018]. 8(1): pp.117-145. Available at: https://doi.org/10.1177/1469540507086422

Cooper, M.C. and Gardner, J.T. 1993. Building Good Business Relationships: More than Just Partnering or Strategic Alliances? [Online Article]. International Journal of Physical Distribution & Logistics Management. [Ref. 16 October

2018]. 23(6). pp.14-26. Available at: https://doi.org/10.1108/09600039310044876

Cooper, M.C., Lamber, D.M. and Pagh, J.D. January 1997. Supply Chain Management: More Than a New Name for Logistics. [Online Publication]. The International Journal of Logistics Management 8(1). p.1-14. [Ref. 16 October 2018]. Available at: https://doi.org/10.1108/09574099710805556

Council of Supply Chain Management Professionals. Undated. CSCMP Supply Chain Management Definitions and Glossary. [Online Article]. Council of Supply Chain Management Professionals. [Ref. 16 October 2018]. Available at: https://cscmp.org/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx?hkey=60879588-f65f-4ab5-8c4b-6878815ef921

Cramer, J. M. February 2008. Organising corporate social responsibility in international product chains. [Online Publication]. Journal of Cleaner Production. [Ref. 12 October 2018]. 16. p. 395-400. Available at: https://www.researchgate.net/publication/223035973_Organising_corporate_social_responsibility_in_international_product_chains

Crossey, S. 24 March 2017. 5 Problems Facing the Global Food Supply Chain, [Online Article]. Food Safety Tech [Ref. 21 October 2018]. Available at: https://foodsafetytech.com/column/5-problems-facing-global-food-supply-chain/

Crossey, S. 9 March 2017. The Five Ts Of The Global Food Supply Chain. [Online Article]. Supply Chain Beyond. [Ref. 19 October 2018]. Available at: https://supplychainbeyond.com/five-ts-global-food-supply-chain/

Dani, S. 2015. Food Supply Chain Management and Logistics - From Farm to Fork. London: Kogan Page

Davenport, T. H. 1993. Process Innovation: Reengineering Work through Information Technology. Boston, MA: Harvard Business School Press

Doorey, D.J. 2011. The transparent supply chain: From resistance to implementation at Nike and Levi-Strauss. [Online Publication]. Journal of Business Ethics. [Ref. 12 October 2018]. 103(4), p. 587-603. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1916325

Egels-Zandén, N. and Sörum, N. 12 February 2015. Supply Chain Transparency as a Consumer or Corporate Tool: The Case of Nudie Jeans Co. [Online Publication]. Journal of Consumer Policy. [Ref. 16 October 2018]. [Restricted Access] Available at: https://link.springer.com/article/10.1007/s10603-015-9283-7

Egels-Zandén, N., Hulthén, K., and Wulff, G. 2014. Trade-offs in supply chain transparency: The case of Nudie Jeans Co. [Online Publication]. Journal of

Cleaner Production. [Ref. 16 October 2018]. Available at: https://doi.org/10.1016/j.jclepro.2014.04.074

Elliott, C. July 2014. Elliott Review into the Integrity and Assurance of Food Supply Networks – Final Report: A National Food Crime Prevention Framework. [Online Publication]. HM Government. [Ref. 19 October 2018]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/350726/elliot-review-final-report-july2014.pdf

Fair Labor Association. Undated. SUPPLY CHAIN TRACEABILITY AND TRANSPARENCY: Shifting Industry Norms, Emerging Regulations, and Greater Interest from Civil Society. [Online Publication]. Fair Labor Association. [Ref. 12 October 2018]. Available at: http://www.fairlabor.org/sites/default/files/images/supply_chain_traceability_and_transparency_june_2017.pdf

Folkerts H. and Koehorst H. 1998. Challenges in international food supply chains: Vertical co-ordination in the European agribusiness and food industries. [Online Publication]. Supply Chain Management: An International Journal. 2(1). pp.11-14. Available at: https://doi.org/10.1108/13598549710156312

Food Safety on NBC News. 22 September 2008. China's top food safety official resigns. [Online Article]. NBC News. [Ref. 23 October 2018]. Available at: http://www.nbcnews.com/id/26827110/

Francis, J. 2018. Closing the Hall of Mirrors: How Blockchain will simplify and transform the Supply Chain. [Online Publication]. Accenture Consulting. [Ref. 13 November 2018]. Available at: https://www.accenture.com/t20180417T123937Z__w__/us-en/_acnmedia/PDF-76/Accenture-Hall-Mirrors.pdf#zoom=50

Franco, P. 24 November 2014, Understanding Bitcoin: Cryptography, Engineering and Economics. 1st edition. p.15. Wiley

Ganeshan, R., Harrison Terry P. 1995. An Introduction to Supply Chain Management. Department of Management Sciences and Information Systems

Gardner, T.A., Benzie, M., Borner, J., Dawkins, E., Fick, S., Garrett, R., ..., Wolvekamp, P. 2018. Transparency and sustainability in global commodity supply chains. In Press. World Development. Available at: https://doi.org/10.1016/j.worlddev.2018.05.025

Gebresenbet, G. and Bosona, T. 2012. The importance of Food Chain logistics as it is the key driver for growth of a crucial economical sector: Food industry. [Online Publication]. Department of Energy and Technology, Swedish University of Agricultural Sciences. Available at: http://cdn.intechopen.com/pdfs/32382/InTech-Logistics_and_supply_chains_in_agricultu%20re_and_food.pdf

Grant, D.B., Trautrims, A. and Wong, C.Y. 2015. Sustainable Logistics and Supply Chain Management. Kogan Page Publishers.

Hall, D. and Braithwuite, A. 2008. The significance of Supply Chain Management.

Harvard University. Undated. Lesson 4: What is the Food Supply Chain? [Online Lecture]. [Ref. 16 October 2018]. Unpublished. Available at: https://hwpi.harvard.edu/files/chge/files/lesson_4_1.pdf

Hobbs, J.E. 1996. A transaction cost approach to supply chain management [Online Article]. Supply Chain Management: An International Journal. [Ref. 16 October 2018]. (2). pp. 15-27. Available at: https://doi.org/10.1108/135985496101

Hofstede, G.J., Spaans, H., Schepers, H., Trienekens, J.H., Beulens, A.J.M. 2004. Hide or Confide: The Dilemma of Transparency. The Netherlands: Reed Business Information.

Horne, R.E. 2009. Limits to labels: The role of eco-labels in the assessment of product sustainability and routes to sustainable consumption. [Online Publication]. International Journal of Consumer Studies. [Ref. 12 October 2018]. Available at: https://doi.org/10.1111/j.1470-6431.2009.00752.x

Huang Y. 16 July 2014. The 2008 Milk Scandal Revisited. [Online Article]. Forbes. [Ref. 23 October 2018]. Available at: https://www.forbes.com/sites/yanzhonghuang/2014/07/16/the-2008-milk-scandal-revisited/#6a054eee4105

Interpol and Europol. October 2016. Report Operation OPSON V 2015 – Targeting counterfeit and substandard foodstuff and beverages. [Online Publication]. Europol. [Ref. 23 October 2018]. Available at: https://www.europol.europa.eu/publications-documents/operation-opson-vi-targeting-counterfeit-and-substandard-foodstuff-and-beverage

Kakavand, H., Kost De Sevres, N. and Chilton, B. 2017. The Blockchain Revolution: An Analysis of Regulation and Technology Related to Distributed Ledger Technologies. [Online Publication]. SSRN. [Ref. 04 November 2018]. Available at: https://ssrn.com/abstract=2849251

Kay, R. 17 December 2001. Supply Chain Management. [Online Article]. Computer World. [Ref. 16 October 2018]. Available at: https://www.computerworld.com/article/2586861/enterprise-resource-planning/supply-chain-management.html

Keith, L.H. 1994. Rethinking traceability. [Online Publication]. ACS Publication. [Ref. 13 October 2018]. 28(13): p. 590A-591A. Available at: https://pubs.acs.org/doi/abs/10.1021/es00062a720

La Scalia, G., Settanni, L., Micale, R. and Enea, M. 2016. Predictive shelf life model based on RF technol-ogy for improving the management of food supply chain: a case study. [Online Publication]. International Journal of RF Tech-nologies. [Ref. 09 October 2018]. Vol. 7 No. 1, pp. 31-42. Available at: https://doi.org/10.3233/RFT-150073

Lambert D.M. 2008. Handbooks of Logistics and Supply Chain Management (Volume 2). In Brewer, A.M., Button, K.J. and Hensher, D.A. Emerald, Inc. pp. 535-539.

Lambert, D.M., Cooper, M.C. and Pagh, J.D. July 1998. Supply Chain Management: Implementation Issues and Research Opportunities. [Online Publication]. The International Journal of Logistics Management 9(2). [Ref. 16 October 2018]. p. 1-20. Available at: https://doi.org/10.1108/09574099810805807

Laudal, T. 2010. An attempt to determine the CSR potential of the international clothing business. [Online Publication]. Journal of Business Ethics. [Ref. 12 October 2018]. 96. p.63-77. Available at: https://link.springer.com/article/10.1007%2Fs10551-010-0449-6

Lee, K.C. 29 April 2015. Handbook of Digital Currency. 1st ed. Elsevier Inc.

Lekakis, E.J. 2013. Coffee Activism and the Politics of Fair Trade and Ethical Consumption in the Global North: Political Consumerism and Cultural Citizenship. Palgrave Macmillan UK. Available at: https://doi.org/10.1057/9781137282699

Li, S., Ragu-Nathan, B., Ragu-Nathan, T.S. and Subba Rao, S. 2004. The Impact of Supply Chain Management Practices on Competitive Advantage and Organizational Performance. [Online Publication]. Omega [Ref. 16 October 2018]. 34. pp. 107-124. Available at: http://dx.doi.org/10.1016/j.omega.2004.08.002

Lipschitz, W.L. and Stokey, E., 1945. The mode of action of three new diuretics: Melamine, adenine and formoguanamine. [Online Article]. Journal of Pharmacology and Experimental Therapeutics. [Ref. 23 October 2018] .83. pp. 235–249.

Marsden, T., Banks, J. and Bristow, G. 2000. Food supply chain approaches: Exploring their role in rural development. [Online Publication]. Sociologia Ruralis. [Ref. 09 October 2018]. Vol. 40 No. 4, pp. 424-438. Available at: https://onlinelibrary.wiley.com/doi/pdf/10.1111/1467-9523.00158

Marquis, C, and Qian, C. April 2013. Corporate Social Responsibility Reporting in China: Symbol or Substance? [Online Publication]. Organization Science. [Ref. 12 October 2018]. p.14. Available at: http://doi.org/10.1287/orsc.2013.0837

McKie, R. 9 Feb 2013. Horsemeat does carry a health risk, but it's incredibly small. [Online Article]. The Guardian. [Ref. 23 October 2018]. Available at:

https://www.theguardian.com/world/2013/feb/09/horsemeat-in-ready-meals-health-risk

Mearian, L. 8 May 2018. Blockchain will be the killer app for supply chain management in 2018. [Online Article]. Computer World. [Ref. 13 November 2018]. Available at: https://www.computerworld.com/article/3249252/emerging-technology/blockchain-will-be-the-killer-app-for-supply-chain-management-in-2018.html

Moisander, J. 13 February 2007. Motivational complexity of green consumerism. [Online Publication]. International Journal of Consumer Studies. [Ref. 13 October 2018]. 31, p.404-409. Available at: https://doi.org/10.1111/j.1470-6431.2007.00586.x

Mougayar, W. and Buterin, V. 2016. The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology. 1st edition. p. 21-22. Wiley

Muhammed, H., Raisa B., Johannes, C. and Mogamat-Yazied, C. March 2018, Unintentional diethylene glycol poisoning following the consumption of a shared alcoholic beverage. [Online Publication]. Research Gate. [Ref. 22 October 2018]. Available at: https://www.researchgate.net/publication/323511965_Unintentional_diethylene_glycol_poisoning_following_the_consumption_upof_a_shared_alcoholic_beverage

Opara L.U. 2003. Traceability in agriculture and food supply chain: A review of basic concepts, technological implications, and future prospects. [Online Publication]. WFL Publisher. [Ref. 16 October 2018]. Available at: https://pdfs.semanticscholar.org/4f63/2b6ec4bd1ebdc53a0fcf295b1cd3800ed11e.pdf

Opara, L.U. and Mazaud, F. 2001. Food traceability from field to plate. [Online Publication]. Research Gate. [Ref. 16 October 2018]. 30(4): p. 239-247. Available at: https://www.researchgate.net/publication/233683672_Food_traceability_from_field_to_plate/citations

Peck, H. 2006. Reconciling supply chain vulnerability, risk and supply chain management. [Online Publication]. International Journal of Logistics Research and Applications. [Ref. 16 October 2018]. p. 127-142. Available at: https://doi.org/10.1080/13675560600673578

Pei X., Tandon, A., Alldrick, A., Giorgi, L., Huang, W. and Yang, R. 2010. The China melamine milk scandal and its implications for food safety regulation. [Online Publication]. Elsevier. [Ref. 23 October 2018]. Available at: http://ssu.ac.ir/cms/fileadmin/user_upload/Mtahghighat/tfood/ARTICLES/chemical_safety/The_China_melamine_milk_scandal_and_its_implications_for_food_safety_regulation.pdf

Peattie, K. and Crane, A. 2005. Green marketing: legend, myth, farce or prophesy? [Online Publication]. Qualitative Market Research: An International Journal. [Ref. 12 October 2018]. 8(4): pp. 357-370. Available at: http://dx.doi.org/10.1108/13522750510619733

Pedersen, E.R and Neergaard, P. 2006. Caveat emptor – let the buyer beware! environmental labelling and the limitations of 'green' consumerism. [Online Publication]. Business Strategy and the Environment [Ref. 12 October 2018]. 15(1). Available at: https://doi.org/10.1002/bse.434

Plaggenhoef van W. 2007. Integration and self-regulation of quality management in Dutch agri-food supply chains. Wageningen University. Doctoral Thesis. Unpublished.

Provenance White Paper. 21 November 2015. Blockchain: the solution for transparency in product supply chains. [Online Publication]. Provenance. [Ref. 13 November 2018]. Available at: https://www.provenance.org/whitepaper

Puschner, B.,, Poppenga, R.H., Lowenstine, L.J., Filigenzi, M.S. and Pesavento, P.A. 2007. Assessment of melamine and cyanuric acid toxicity in cats. [Online Article]. Journal of Veterinary Diagnostic Investigation. [Ref. 23 October 2018].19. pp. 616–624. Available at: https://doi.org/10.1177/104063870701900602

PWC report. 14 Jan 2016. Fighting $40bn food fraud to protect food supply. [Online Publication]. PWC Press Room. [Ref. 19 October 2018]. Available at: https://press.pwc.com/News-releases/fighting--40bn-food-fraud-to-protect-food-supply/s/44fd6210-10f7-46c7-8431-e55983286e22

Richero, R. and Ferrigno, S. 4 July 2017. A Background Analysis on Transparency and Traceability in the Garment Value Chain [Online Publication]. DAI Europe and Office for Economic Policy and Regional Development (EPRD). [Ref. 16 October 2018]. p.15-16. Available at: https://ec.europa.eu/europeaid/sites/devco/files/final_report_04-07-2017.pdf

Roekel, J V, Willems, S and Boselie, D M. 2002. Agri-Supply Chain Management: To stimulate cross-border trade in developing countries and emerging economies. Washington, DC: World Bank. Available at: http://www.infodev.org/infodev-files/resource/InfodevDocuments_923.pdf

Rueda, X., Garret, R.D and Lambin E.F. 2016. Corporate investments in supply chain sustainability: Selecting instruments in the agric-food industry. [Online Publication]. Journal of Cleaner Production. [Ref. 21 October 2018]. p.142. Available at: https://doi.org/10.1016/j.jclepro.2016.11.026

Sebastian, M. 2009. Handbook of Toxicology of Chemical Warfare Agents. Elsevier Inc. [Ref. 22 October 2018]. [Restricted Access]. Available at: https://doi.org/10.1016/B978-0-12-374484-5.X0001-6

SGS. 2 August 2018. Understanding Transparency and Traceability in The Supply Chain. [Online Article]. SGS Company. Available at: https://www.sgs.com/en/news/2018/08/understanding-transparency-and-traceability-in-the-supply-chain

Shufeng, W., Liya, M. and Wei, W. 2010. Modern agriculture logistics' function elements and its systematic operational management [Online Article]. Information Science and Engineering (ICISE), 2010 2nd International Conference on Hangzhou, China. P. 2188 – 2192. Available at: https://ieeexplore.ieee.org/document/5689768/

Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E. 2003. Designing and managing the supply chain: concepts, strategies, and case studies. 2nd edition. Boston (Mass.): McGraw-Hill

Spencer, R. 22 Jan 2009. Two sentenced to death over China melamine milk scandal. [Online Article]. The Telegraph. [Ref. 23 October 2018]. Available at: https://www.telegraph.co.uk/news/worldnews/asia/china/4315627/Two-sentenced-to-death-over-China-melamine-milk-scandal.html

Statista. Undated. Food and Beverages in Finland. [Ref. 12 November 2018]. Available at: https://www.statista.com/outlook/253/135/food-beverages/finland

Statistics Finland. 04 April 2017. Population: Population structure 31 December. [Ref. 12 November 2018]. Available at: https://www.tilastokeskus.fi/tup/suoluk/suoluk_vaesto_en.html

Tagliablue, J. 1985. Scandal Over Poisoned Wine Embitters Village in Austria, [Online Article]. The New York Times. [Ref. 22 October 2018]. Available at: https://www.nytimes.com/1985/08/02/world/scandal-over-poisoned-wine-embitters-village-in-austria.html

Tan, D. 2012. Developing Agricultural Products Logistics in China from the Perspective of Green Supply Chain. [Online Article]. International Journal of Business and Management. 13. Available at: 10.5539/ijbm.v7n21p106

Telegraph Food. 8 February 2013. Horse meat scandal: timeline. [Online Article]. The Telegraph. [Ref. 23 October 2018]. Available at: https://www.telegraph.co.uk/foodanddrink/9857136/Horse-meat-scandal-timeline.html

Trienekens, J., Petersen, B., Wognum, N. and Brinkmann, D. 2009. European Pork Chains-Diversity and Quality Challenges in Consumer-oriented Production

and Distribution. Wageningen, The Netherlands: Wageningen Academic Publishers.

U.S. Department of Health and Human Services and Office of Enforcement. 11 March 2003. Guidance for Industry: Product Recalls, Including Removals and Corrections. [Online Publication]. US Food and Drug Administration (FDA). [Ref. 22 November 2018]. Available at: https://www.fda.gov/Safety/Recalls/IndustryGuidance/ucm129259.htm

United Nations Economic Commission for Europe. 2013. Forest Products: Annual Market Review 2012-2013. [Online Publication]. United Nations Economic Commission for Europe. [Ref. 16 October 2018]. Available at: http://www.unece.org/fileadmin/ DAM/timber/publications/FPAMR2013.pdf

Wang L., 2012, Study on Agricultural Products Logistics Mode in Henan Province of China. In: Wu Y. (eds) Software Engineering and Knowledge Engineering: Theory and Practice. Advances in Intelligent and Soft Computing. vol 115, [Restricted Access]: http://link.springer.com.ezproxy.lib.ukm.si/chapter/10.1007/978-3-642-25349-2_84

Wang Shufeng, W., Liya, M. and Wei, W. 2010. Modern agriculture logistics function elements and its systematic operational management. [Online Publication]. Information Science and Engineering (ICISE). [Ref. 09 October 2018]. pp. 2188 – 2192. Available at: https://doi.org/10.1109/ICISE.2010.5689768

Waters, D. 2007. Supply Chain Risk Management - Vulnerability and Resilience in Logistics. 1st edition. Kogan Page Publishers

Wenger, A. 2013. Bitcoin as Protocol [Online Article]. Union Square Ventures. [Ref. 31 October 2018]. Available at: https://www.usv.com/blog/bitcoin-as-protocol

Wessel, D. 11 January 2016. The Hutchins Center Explains: How blockchain could change the financial system (part 1). [Online Article]. Brookings. [Ref. 31 October 2018]. Available at: https://www.brookings.edu/blog/up-front/2016/01/11/the-hutchins-center-explains-how-blockchain-could-change-the-financial-system-part-1/

Wong, J.I. Undated. WALMART: The world's biggest retailer wants to bring blockchains to the food business. [Online Article]. Quartz. [Ref. 21 October 2018]. Available at: https://classic.qz.com/perfect-company-2/1146289/the-worlds-biggest-retailer-wants-to-bring-blockchains-to-the-food-business/

Wood D., Barone A., Murphy P. and Wardlow D. 2002. International Logistics. 2nd Edition. New York: Amacom

Woods, E. 1999. Supply chain management. [Article]. ACIAR Postharvest Technology Internal Workshop No. 20. Canberra.

World Health Organization. 3 December 2015. WHO's first ever global estimates of foodborne diseases find children under 5 account for almost one third of deaths. [Online Article]. World Health Organization. [Ref. 19 October 2018]. Available at: http://www.who.int/en/news-room/detail/03-12-2015-who-s-first-ever-global-estimates-of-foodborne-diseases-find-children-under-5-account-for-almost-one-third-of-deaths

World Health Organization. Undated. Questions and Answers on melamine. [Online Publication]. World Health Organization. [Ref. 23 October 2018]. Available at: http://www.who.int/csr/media/faq/QAmelamine/en/

Wright, A., Primavera, D.F. 10 March 2015. Decentralized Blockchain Technology and the Rise of Lex Cryptographia [Online Publication]. Elsevier Inc. [Ref. 31 October 2018]. p. 8-9. Available at http://ssrn.com/abstract=2580664.

Young, W., Hwang, K., McDonald, S. and Oates, C.J. 2009. Sustainable consumption: green consumer behaviour when purchasing products. [Online Publication]. Wiley. [Ref. 12 October 2018]. Available at: https://doi.org/10.1002/sd.394

Zheng, Z., Xie, S., Dai, H.N., Chen, X. and Wang, H. 2018. Blockchain challenges and opportunities: A Survey. [Online Publication]. International Journal Web and Grid Services. [Ref. 04 November 2018]. p.357. Available at: https://www.henrylab.net/wpcontent/uploads/2017/10/blockchain.pdf

Zyglidopoulos, S., & Fleming, P. 2011. Corporate accountability and the politics of visibility in 'late modernity'. [Online Publication]. Available at: https://doi.org/10.1177/1350508410397222

# APPENDICES

APPENDIX 1. Interview questions

APPENDIX 1. Interview questions

For Atria

1. Can you briefly introduce about yourself? What do you do at Atria? How well do you familiarize yourself with Atria's Supply Chain model?
2. Can you please define your company's role in the Food Supply Chain network (based on your working area, you can describe it in retail environment)? For example: Is Atria a farmer, supplier of a specific food materials for production or other purposes, processor, transporter, distributor or retailer?
3. Does your area of expertise involve international trading?
4. Can you describe the Supply Chain model/network of Atria's Meat & Poultry product line in brief?
5. Can you describe your "recalling procedure" whenever there is an event of food scare occurs? Please also specify the time duration of this procedure.
6. How is your meat and poultry tracing system operating? Does it involve at all the use of Blockchain technology?

    - Are the data/information recorded in the tracing system accessible and modifiable by other stakeholders within the chain? If yes, is it shared via some kinds of platform?
    - Is this recorded data/information secured and tamper-proof?

7. Does this meat and poultry tracing system only operate within Finland? Are there any possibilities to apply this technology to Atria's international trading activities where the company does not have full control and creditability over the partners located overseas? (Or in other words, is it possible to scale-up your tracing system to international trades?)
8. How does this tracing system affect the traceability and transparency of Atria's Food Supply Chain in general? Or does it only affect directly to the awareness of consumers without any significant benefit to the operation of Atria?

- If it affects Atria's operation, then in what manner? (Help to improve the auditability of the authority? Improve the traceability of involved stakeholders? Enhance the transparency of the entire chain?) Please specify.
- How does your customers respond to the meat and poultry tracing system?

9. Do you think that there might be an opportunity to integrate Blockchain Technology into your established tracing system?

    - If yes, can you please specify your expectations about the technology?
    - If not, can you please specify the reason for your refusal?

<u>For Walmart</u>

1. Can you briefly introduce about yourself? What do you do at Walmart? How well do you familiarize yourself with Walmart's Supply Chain model?
2. Can you please define your company's role in the Food Supply Chain network (based on your expertise on the subjected field, can you describe it in the retail environment)?
3. Does your area of expertise involve international trading?
4. Can you describe the Supply Chain model/network for Mango product line in brief?
5. Can you describe your "recalling procedure" whenever there is an event of food scare occurs? Please also specify the time duration of this procedure.

6. How do you evaluate the effectiveness and the efficiency of integrating Blockchain technology into your Food Supply Chain Management system? What are the most prominent benefits observed while using the technology?

7. Can you specify the pros and cons of the integration? Any possible solutions to tackle the current challenges, if any?

8. From your experience, do you think that Blockchain Technology is contributing to the mitigation of the company's operational risks?

9. What are your recommendations for other companies which are planning to implement the integration of Blockchain Technology into their FSCM system or performing researches on the given subject?