# Interactions between traceability, governance mechanisms and transaction elements


## A case study in the cocoa-chocolate supply chain

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## Acknowledgements

During my Bachelor Business and Consumer studies at the Wageningen University, I became very interested in food supply chains and the management of these supply chains. I tried to combine this interest together with my endless curiosity about food products (where these food products are from, what they contain and how they are produced), into a thesis topic. After having some thoughts about it, a fitting and enthralling topic popped up in my mind: 'traceability in food supply chains'.

Four months of intensive research followed, resulting in this thesis. I could not have done it alone, so I would like to thank some people here. First of all, I would like to thank my thesis coach Jacques Trienekens for providing me helpful feedback and guidance. Secondly, I want to thank my co-reader Stefano Pascucci for his final inputs. Finally, I want to thank my boyfriend , family and friends for their support and valuable inputs.

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## Abstract

Nowadays, the Netherlands is under the spell of food fraud issues. In order to get a grip on food fraud, traceability might be an important tool to assure the quality of a food product. The aim of this study was to explore governance mechanisms and transaction elements, influencing these governance mechanisms, interacting with traceability and to develop a framework based on these interactions. Such an investigation of factors influencing traceability has not been done yet. The social aim of the study is to provide companies insight in the interactions around traceability, so that they can get a better understanding of it and that they can use this information when designing or improving a traceability system. The research question to be answered was: 'How do traceability systems, governance mechanisms and transaction elements influencing these governance mechanisms of a food supply chain interact, in order to assure a food product's origin and used production methods?'. The interactions between these governance mechanisms, transaction elements and traceability were studied by doing a literature study and after that, the validity of the findings was checked by a limited case study in the cocoa-chocolate supply chain.

The focus of this study was on three different categories of governance mechanisms, namely standards, more formal governance mechanisms, derived from Transaction Cost Economics, and more informal governance mechanisms, derived from Social Network theory. Environmental uncertainty, difficulty of performance measurement and transaction-specific investments were taken as the three transaction elements. In the literature, it was found that a traceability system has five important elements to take into account when implementing traceability. In this study, a distinction is made between the traceability strategy and the four traceability implementation elements, which together form a traceability system.

In this study, it was found that there are several interactions between governance mechanisms, transaction elements and traceability systems. It was found that there are interactions between the traceability strategy and transaction elements, standards and transaction elements, transaction elements and traceability elements, standards and traceability strategy, standards and traceability implementation elements, informal governance mechanism and traceability system, and between the traceability strategy and traceability implementation elements. An explanation of these interactions can be found in this thesis.

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# Chapter 1 'Introduction'

## 1.1 Food fraud as hot topic these days

Nowadays, the Netherlands is under the spell of food fraud issues. Certain food products that claimed only to contain beef turned out to also contain horsemeat. The Dutch Broadcasting Foundation (NOS) writes the following headlines about this problem: 'Consumers are cheated with meat and fish', 'Super busy at laboratories due to food fraud research', and 'Companies want to make sure that their beef does not contain any horsemeat'. The problem is broader than the horsemeat affaire. In Germany eggs are sold with a biological label, which guarantees certain living conditions of the chickens. However, some farms do not live up to these living conditions, although they sell their eggs with this biological label. There are also rumours that cheap raw materials and water are added to food to increase the weight of the product. This is allowed when it is mentioned on the packaging, but this does not always happen.

The food fraud affair is not only a hot item in the news, but also within the government. At the end of March 2013, the minister of Public Health of the Netherlands decided that companies which committed food fraud will get high penalties and that these companies are at risk of being closed. The minister increased the fine ceiling from €4500 to €78000 (Volkskrant, 2013). The minister also decided that the planned cuts of 4.2 million euros on the Dutch Food and Consumer Product Safety Authority, which is among others responsible for food quality inspections, will not be implemented. Furthermore, the Dutch Food and Consumer Product Safety Authority is going to periodically check the information on product labels, to prevent food fraud issues in the future.

## 1.2 Traceability to assure food quality

In order to get a grip on food fraud, traceability might be an important tool to guarantee or assure the quality of a food product. Traceability is the ability to track a product's flow or attributes throughout the production process and supply chain (Golan et al, 2004). Several researchers state that traceability might be important for the assurance of the quality of a food product (Roth et al, 2008; Marucheck et al, 2011; Van der Vorst, 2004).

The quality of a food product covers safety requirements, conformity to commodity standards, nutritional requirements, sensory requirements, production context requirements and ethical requirements (Luning and Marcelis, 2009). In this research the focus will be on the production context requirements of quality, which includes the origin of the product and the used production methods, and the ethical requirements. According to Coff et al (2008) traceability relates to where and how products are produced. From this definition, the production context requirements are derived as relevant aspects of quality for traceability. Ethical requirements are also included in this study, because Dutch consumers link information about the origin of the product to ethical concerns, like the working conditions in certain countries (Giraud and Halawany, 2006).

## 1.3 Aim of the study

The design of a traceability system and what the company implementing it wants to achieve with its traceability system is likely to be dependent of multiple factors. Furthermore, the implemented traceability system might also influence particular factors itself. In this research, the focus is on organisation of food supply chains, because a lack of chain organisation might be a barrier for the implementation of traceability (Van der Vorst, 2004). Therefore, the organisation of a supply chain or how transactions are coordinated in the chain might have an important influence on the possibilities for traceability. The way in which a transaction is coordinated is called a governance mechanism. The scientific aim of this study is to explore governance mechanisms and transaction elements influencing these governance mechanisms interacting with traceability and to develop a 'traceability interaction framework' based on these interactions. Such an investigation of factors influencing traceability has not been done yet. The framework is developed based on literature study and after

that, the validity of the findings was checked by a limited case study. The social aim of the study was to provide companies insight in the interactions around traceability, so that they can get a better understanding of it and that they can use this information when designing or improving a traceability system.

## 1.4 Research questions

The research question to be answered is: 'How do traceability systems, governance mechanisms and transaction elements influencing these governance mechanisms of a food supply chain interact, in order to assure a food product's origin and used production methods?'.

In order to be able to answer the research question, the following sub questions need to be answered:

- Which elements are important when traceability is implemented in order to guarantee the origin and production methods of a food product?
- In which ways do governance mechanisms and transaction elements influencing these governance mechanisms in a food supply chain interact with a traceability system and how can a traceability interaction framework be developed based on these interactions?
- How is the cocoa - chocolate supply chain set up and what is the result of the application of the traceability interaction framework to this supply chain?

In the next chapter, an introduction on traceability will be given and the possible important elements to take into account when designing and implementing a traceability system will be outlined. In the third chapter, the governance mechanisms and the transaction elements, which might be interacting with traceability will be explored. Based on these interactions, a traceability interaction framework will be developed, which shows the interactions between the traceability system, governance mechanisms and transaction elements in the supply chain. To test the validity of this framework, an application of the framework to the cocoa-chocolate chain will be performed in the fourth chapter. In the fifth and sixth chapter, a conclusion and discussion will be given.

# Chapter 2 'Traceability'

According to Golan et al (2004), traceability is the ability to track a product's flow or attributes throughout the production process and supply chain. The European Union developed a definition of traceability specifically for the food industry as the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution (EU, 2002). This tracking and tracing of food products through the whole chain can provide information about among others the origin of a product (Thompson, 2005). The question to be answered in this chapter is 'How can traceability be implemented in the supply chain in order to guarantee the origin and production methods of a food product?'.

## 2.1 Types of traceability

Two types of traceability are distinguished in the literature based on the direction of the information, namely forward and backward traceability (see Figure 1). Backward traceability or tracing is the ability to find origin and characteristics of a product at every point of the supply chain. Tracing is about the history of a product, so the following questions will be important: 'Where is the product from?' and 'Where has the product been and what has happened there with the product?'. With tracing, the origin of certain problems within a product can be localised (Van der Vorst, 2004). Forward traceability or tracking on the other side is the ability to localise a product at every point in the supply chain (Jansen-Vullers et al, 2003). Tracking also involves following a product down the supply chain. When a problem within a product is recognised, tracking can be used to determine to which customers that product is delivered (Van der Vorst, 2004). Therefore, tracking might be very important for recall management.

In the literature also another distinction is made between two types of traceability based on the usage of the traceability system. These types are passive and active traceability (Jansen-Vullers, 2003). Passive traceability involves the ability to localise and identify characteristics of the product in case of calamity. Active traceability means that traceability is actively used in the supply chain to manage quality information. This type of traceability may decrease failure costs, increase productivity and may better guarantee quality (Jansen-Vullers, 2003).

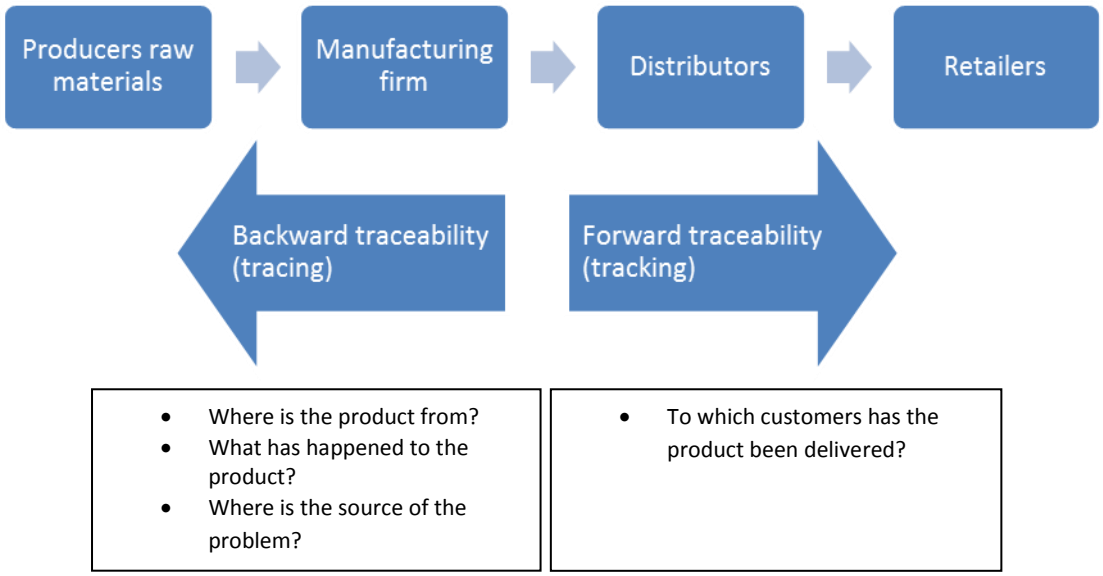


Figure 1: 'Different types of traceability'

## 2.2 Traceability and quality assurance

Traceability might be very valuable for the guarantee of the origin and used production methods of a product. According to Leat et al (1998), traceability is essential in a food supply chain for a number of reasons. Firstly, it can provide assurance of the origin, safety and quality of a food product to consumers. In this way, companies might maintain customer confidence (Van der Vorst, 2004). Secondly, traceability allows identification of the source of an infected product. Thirdly, it can be used for disease control and residue monitoring, and to measure verification.

Hobbs et al (2005) studied the economic incentives of implementing a traceability system. They conclude that using traceability to assure a food product's quality can increase the value of traceability to consumers.

## 2.3 Advantages of implementing traceability

Implementing a traceability system will have advantages. Buhr (2003) did a case study on traceability in the meat and poultry sector in which six European companies were studied. All of these companies recognised internal benefits of implementing traceability, namely improvements in data collection and analysis, which led to improved information and control of production. This result was also found in the research of Trienekens and Van der Vorst (2006). They reported that traceability systems can be beneficial for the control and optimisation of processes. Another advantage is that by using a traceability system, problems within a product can be recognised in time, which will result in effective recall management (Trienekens and Van der Vorst (2006); Opara (2002)). According to Buhr (2003), this could result in less recall costs.

## 2.4 Barriers to the implementation of traceability

On the other side, implementing a traceability system will also have certain barriers. According to Daives (2004), more than sixty per cent of the companies in the food industry are small and medium enterprises. The costs of implementing and maintaining a traceability system will be much higher than the expected benefits for small and medium enterprises (Daives, 2004). Buhr (2003) recognised that the value and costs of a traceability system differs between companies due to differences in for example the costs of control procedures, costs of recall and potential reputation damage costs. This means that the value of traceability to a particular company will be different and difficult to estimate. Other barriers to the implementation of traceability are a lack of chain organisation and a lack of standardisation, which means that every company collects and processes data in a different way (Van der Vorst, 2004). This makes it difficult to exchange data in the supply chain.

## 2.5 Implementing traceability

According to Buhr (2003), it depends on the characteristics of the supply chain whether implementing traceability is preferred or not. When there is information asymmetry in upstream processes, low task observation, high production quality or quantity uncertainty in upstream suppliers and the costs of supervision and monitoring are high, traceability is preferred. However, when there only exists information asymmetry between the retailer and the end-consumer and there is a limited number of suppliers with a high frequency of purchasing, other methods like branding, labelling and certification might be used in order to create information symmetry (see Figure 2). These insights imply that it will be necessary firstly to analyse a supply chain in order to determine the characteristics of the supply chain. The identified characteristics determine whether it might be valuable to use traceability to guarantee the quality of a food product. The rule of thumb which can be used is that the simpler the physical logistic control problem, the observability and controllability of characteristics and inputs, the less valuable the implementation of traceability in the supply chain will be (Buhr, 2003). It is however important to realise that the European Union has some laws and regulations on traceability in food supply chains. This legislation states that it is obligatory for

products that are produced in the EU, imported in the EU or exported from the EU to track and trace one step backward and one step forward in the chain. So independent of the factors identified by Buhr (2003), each company in such a food supply chain in the EU needs to have a traceability system. The factors of Buhr (2003) would be useful then to determine whether it might be valuable to extent an existing traceability system, so that it is possible for example to track and trace the products throughout the whole supply chain. When there are no law and regulations on traceability, the factors of Buhr (2003) might be used to determine whether traceability is valuable or not.

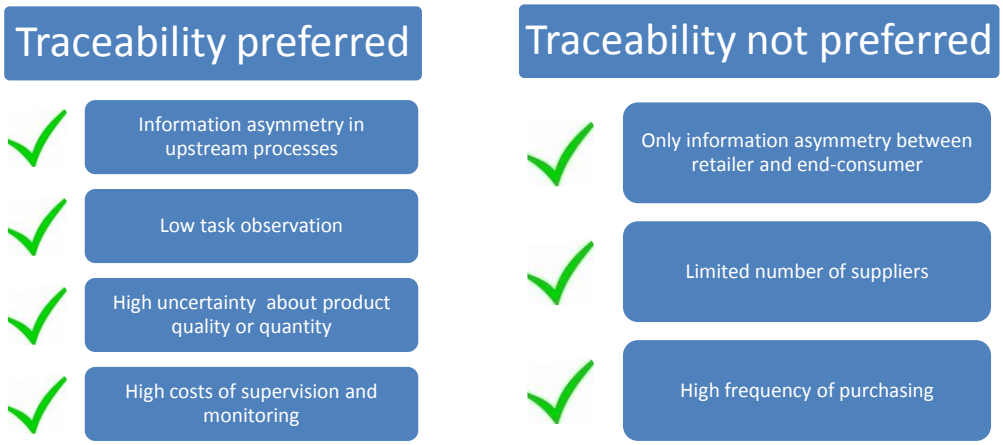


**Figure 2: 'When to implement traceability', based on Buhr (2003).**

Hobbs (2003) stated that it is important to distinguish between the function of traceability in supply chain management and the function of traceability towards consumers. When traceability does not lead to direct benefits to consumers, while it implies high costs to implement the system, it does not immediately mean that traceability is not important. In its role in supply chain management, traceability can reduce transaction costs of managing relationships with suppliers, improve internal processes and contribute to effective recall management.

In the literature, several example steps for the implementation of traceability are described. In this study, the traceability implementation steps identified by Buhr (2003) and Mgonja (2007) will be outlined. Buhr (2003) identified the following aspects that need to be taken into account when implementing traceability: choice of an information system, whether access to this information system will be via Internet or via the company's own information system, which methods will be used to identify products (RFID or barcodes) and which hardware and devices to use for the measurement. Mgonja (2007) also identified some elements that should be taken into account when designing a traceability system and he made a very clear overview of these elements. The identified elements are the following:

1. Defining a strategy and objective of the traceability system
2. Identifying unique identity of products, logistic units and locations
3. Capturing and recording of data
4. Data retrieval and link to management
5. Communication of traceability data

The aspects identified by Buhr and Mgonja have some overlap, but there are two main differences, namely in the level of abstraction and the scope of application. The first main difference is that Mgonja uses a higher level of abstraction than Buhr and that the aspects of Buhr can be seen as examples of some aspects identified by Mgonja. Buhr for example names RFID and barcodes as possibilities for the identification of products. Mgonja gives the aspect 'capturing and recording of data', which involves decision making about how to collect data and identify products. The RFID

technology and barcodes identified by Buhr can be seen as examples of Mgonja's aspect 'capturing and recording of data'. Besides the level of abstraction as a difference between Buhr and Mgonja, another difference is the scope of the identified aspects. Buhr really focuses on all the technological aspects of the implementation of traceability, while Mgonja also focuses on the strategy and the communication. Therefore, the scope of the aspects identified by Mgonja is broader. Another difference between the aspects of Buhr and Mgonja is the way the aspects are presented. Mgonja developed some clear steps on which companies have to focus when implementing a traceability system, while Buhr does not present his aspects in a logical sequence that companies can follow. Because of the clear sequence of steps, the broader scope and the higher level of abstraction, the aspects of Mgonja will be used in this study.

## 2.6 Mgonja's framework

In this paragraph, the different traceability implementation steps from Mgonja's framework will be described. New insights from literature will be added to this framework.

### *Step 1 Defining a strategy and objective*

According to Luning and Marcelis (2009) the traceability strategy of a company or supply chain depends on the trade-off between the costs and benefits associated with traceability. High levels of traceability on the one hand require high investments, but on the other hand could result in improvements in processes, effective recall management, etcetera. Therefore, each company or supply chain should make such a trade-off between costs and potential benefits and thereby determine an appropriate traceability strategy.

Van der Vorst (2004) identified three main traceability strategies. The first one is a compliance-oriented strategy, which means that the focus is on complying to rules and regulations. The level of traceability will probably be low. The second one is the process improvement-oriented strategy, which means that a company strives for traceability within the own company to comply with rules and regulations, but also to realise a better return. The third strategy is the market-oriented strategy, which implies full traceability throughout the whole supply chain to create added value.

Next to the strategy, as the main determinator of the level of traceability, the traceability objective has a big influence on the design and performance of the traceability system (Luning and Marcelis, 2009). The traceability objective of the company reflects what the company wants to achieve with the traceability system. When the traceability objective of a company is for example to comply with laws and regulations, the level of traceability will probably be low. However, when the objective of a company is to provide information to customers and trading partners, traceability throughout the whole supply chain might be needed. This might result in a high level of traceability. In this way, the traceability objective has influence on the design and desired performance of the traceability system.

### *Step 2 Identify unique identity of products, logistic units and locations*

Firstly, all relevant locations in the supply chain need to be identified and defined (ECR, 2004). This means that it should be clear which actors there are and what their role is in the supply chain. After this, the relevant trade items or traceable resource units (TRU) in the supply chain need to be defined (Luning and Marcelis, 2009). According to the ECR (2004) 'a trade item is a product or service, on which there is a need to retrieve predefined information and that may be priced or ordered or invoiced at any point in the supply chain'. Furthermore, the logistic units or pallets, consisting of trade items, used in the supply chain have to be defined. According to the ECR (2004) 'a logistic unit is an item of any composition established for transport and/or storage, which needs to be managed throughout the supply chain' (ECR, 2004). A logistic unit can be uniform, which means that it consists of multiple identical products of the same or different batches, or it can be mixed, which means that it contains different products from different batches (ECR, 2004).

The locations, traceable resource units and logistic units need be identifiable and their identity should be unique. This can be done by identifiers, which should uniquely identify units, be secure, be permanent, retain identity throughout the life cycle of a product, be simple to read and capture identifying data (Thompson, 2005; Mgonja, 2007). An example of common used identifiers are the EAN-UCC (European Article Numbering – Uniform Code Council) identifiers. These identifiers are used globally and they are universally accepted by consumers, governments and businesses (ECR, 2004). According to the ECR (2004), the EAN-UCC Global Location Number (GLN) can be used as an identifier for the location. To uniquely identify a trade item, the EAN-UCC Global Trade Item Number (GTIN) identifier can be used. In order to achieve traceability, also a Serial Number or Lot Code (i.e. batch number) needs to be added to the Global Trade Item Number identifier (ECR, 2004). The logistic units or pallets could be identified by the use of EAN-UCC Serial Shipping Container Codes (SSCC). The SSCC should be added to the pallet when the pallet is physically created (ECR, 2004). For example, when a pallet is formed after the production of a product, a SSCC should be added to that pallet. When some products of that pallet need to be added to another pallet in a warehouse to prepare a delivery, a new SSCC is required. Additional information about product and/or production attributes can be added by EAN-UCC Application Identifiers (ECR, 2004).

### *Step 3 Capturing and recording of data*

The data relevant for traceability should be stored at the different actors of the supply chain and shared between them. Deasy (2002), Sahin (2002), Regattieri (2007) and Thakur (2011) state that information technology can offer important tools in order to create traceability in food supply chains. According to Luning and Marcelis (2009), the recommended technology for storing and sharing data is 'automated identification and data collection/capture' (AIDC). According to the Association for Automatic Identification and Mobility (2013) AIDC are 'the terms used to describe direct entry of data into a computer system, programmable logic controller, or other microprocessor-controlled device without using a keyboard'.

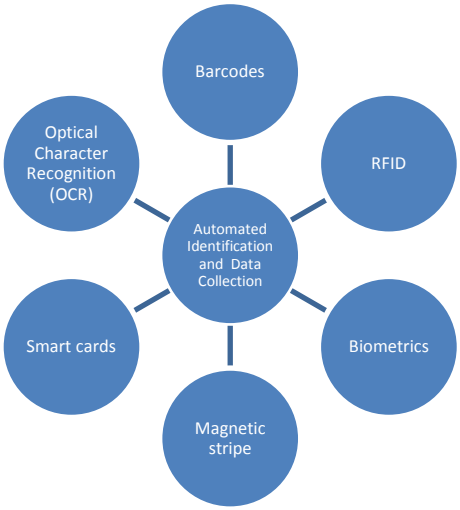


**Figure 3: 'Automated identification and data collection', adopted from Trienekens and Van der Vorst (2006)**

AIDC includes the following technologies:
Barcodes, Radio Frequency Identification, Magnetic stripe, Optical Character Recognition, Biometrics and Smart cards (Trienekens and Van der Vorst, 2006) (see Figure 3). By using AIDC, manual data collection and data entry are eliminated (AIM, 2013). AIDC can be very valuable for quality assurance, because in factories problems can be solved at the source, in the distribution centres there is improved quality assurance and the conditions during transportation can be better controlled, which will result in improved quality assurance (DTI, 2001).

RFID, barcodes and biometrics are widely used for product identification and registration in food chains (Trienekens and Van der Vorst, 2006). Regattieri (2007) draws corresponding conclusions by stating that barcodes and RFID are the most common used IT tools in practice to create traceability. Therefore, these technologies will be described below. According to Trienekens and Van der Vorst (2006), Optical Character Recognition, Magnetic Stripe, and Smart Cards are not used very often in food companies. Therefore, these technologies will not be outlined in this study.

## RFID Technology

Radio Frequency Identification (RFID) is a technology that uses electronic tags instead of barcodes to identify objects (Turban and Volonino, 2007). A tag consists of a microchip, which contains information, and an antenna (Kelepouris et al, 2007). The tags can be attached to or embedded in packages of a product. The antenna of the tag makes it possible to transmit the information of the chip via radio waves to a RFID reader, which transforms these radio waves into digital information (Kelepouris et al, 2007). A back office data-processing equipment will be needed to process all collected data (Wu et al, 2006). According to Kelepouris et al (2007) Radio Frequency Identification technology offers opportunities for an effective and efficient traceability system, because it can be used to identify products.

According to GCI (2005), the most important application areas of RFID are store operations, distribution operations, direct-store-delivery, promotion/event execution, total inventory management based on their performance versus the ratio of expected benefits and costs. There are opportunities for RFID in other traceability activities, for example recalls, fresh product management, cold chain monitoring, and legal compliance, but further investigation is needed (GCI, 2005).

## Barcodes

According to Luning and Marcelis (2009) a barcode is a machine-readable code consisting of a series of bars and spaces printed in defined ratios. A barcode scanner can convert the barcode into an electrical signal and then a decoder processes the information encoded in this electrical signal. According to Smith and Offodile (2002) barcodes can be used for quality assurance.

A summary of the main advantages and disadvantages of RFID and barcodes can be found in Table 1. A more extensive description of these advantages and disadvantages can be found in Appendix 1.

| Technology: | Advantages: | Disadvantages: |
|---|---|---|
| **RFID** | 1. Automated capturing of data → less labour costs (Kelepouris et al, 2007; Sahin et al, 2002).<br>2. Implementing traceability would only require small changes in existing business processes (Kelepouris et al, 2007).<br>3. Tags do not have to be placed in a certain position for identification → simple and rapid identification (Sahin et al, 2002).<br>4. RFID tags are less prone to damage than for example barcodes (Fawcett et al, 2007). | 1. Difficult implementation due to costs, privacy and security concerns (Turban and Volonino, 2012).<br>2. Implementation of traceability on detailed level → amount of information to be managed becomes very big (Jansen-Vullers, 2003) and the costs become quite high (Buhr, 2003)<br>3. There are some challenges when implementing RFID in a supply chain, namely technology, standardization, patent, costs, infrastructure, return on investment and barcode to RFID migration challenges (Wu et al, 2006).<br>4. Scanning problems under certain electromagnetic conditions (Rizzi and Zamboni, 1999). |
| **Barcode** | 1. Highly accurate way to identify products (Smith and Offodile, 2002).<br>2. Identification of products can take place at relatively high speed (Regattieri et al, 2007).<br>3. Automated way to identify products.<br>4. Barcodes are relatively cheap (Regattieri et al, 2007).<br>5. Whereas scanning problems exist under certain electromagnetic conditions for RFID, this problem is absent for barcodes (Rizzi and Zamboni, 1999). | 1.Amount of information that can be stored on a barcode is limited (Kelepouris, 2007).<br>2. Barcode requires a line-of-sight to be able to scan it, which implies human intervention → higher labour costs (Kelepouris, 2007).<br>3. Barcode is vulnerable for damage (Regattieri et al, 2007).<br>4. There are many barcode symbologies, which makes it difficult to implement traceability in a supply chain (Trienekens and Van der Vorst, 2006). |

**Table 1: 'Advantages and disadvantages of RFID and Barcodes'**

### Biometrics

According to Trienekens and Van der Vorst (2006), biometrics is the general term for all procedures that identify people by comparing unmistakable and individual physical characteristics. Examples of biometrics used in practice are voice identification, fingerprinting, retina identification and DNA analysis (Shanahan et al, 2009). In the food sector DNA analysis is used for the identification of animals (Luning and Marcelis, 2009). However, biometrics are still too expensive for large-scale applications (Trienekens and Van der Vorst, 2006). According to Shanahan et al (2009), biometrics are also too slow for large-scale applications. More research is required for the further development of biometrics (Shanahan et al, 2009).

## *Step 4 Data retrieval and link to management*

When the traceability data are collected with the usage of one of the AIDC technologies described in step 3 'Capturing and recording of data', the next step is to integrate the AIDC technology with administrative systems. This simplifies the analysis and exchange of data, which is critical for traceability throughout the whole supply chain (Luning and Marcelis, 2009). To guarantee the performance of the traceability system, each actor in the supply chain needs to manage the data of received products/inputs, what is produced, packed, stored and delivered.

There are different systems available for the integration of traceability data with the administrative system. Examples of these systems are Enterprise Resource Planning (ERP) systems, Warehouse Management Systems (WMS), and Laboratory Information Management Systems (LIMS) (Luning and Marcelis, 2009). A description of each of these systems will be given below.

### Enterprise Resource Planning system

According to Gable (1998) an Enterprise Resource Planning system is a comprehensive package of software solutions seeking to integrate the complete range of a business processes and functions in order to present a holistic view of the business from a single information and IT architecture. Rosemann (1999) gives another definition of ERP, namely as a customisable, standard application software which includes integrated business solutions for the core processes and the main administrative functions of a company. Although these two definitions are slightly different, the core of the two definitions is the same, namely that ERP tries to integrate the whole company with its processes and functions into one software package. Another important characteristic of an ERP system is that all data collected in the company are stored in one common database (Su and Yang, 2010).

### ERP and traceability

According to Rizzi and Zamboni (1999), to reach high data reliability and limit the amount of errors, integration between information flows and applications is required. The higher the automation and integration of an information system, the easier to trace back items and the more reliable the available data (Rizzi and Zamboni, 1999). An ERP system might be effective for improving traceability, because ERP integrates different software modules, data storage and retrieving processes and its management and analysis functions (Rizzi and Zamboni, 1999). Furthermore, an ERP system can improve the transparency in the supply chain by removing information distortions and increasing the speed of information flows by reducing information delays (Akkerman et al, 2003).

The main advantages and disadvantages of using an ERP system can be found in Table 2. A more extensive description of these advantages and disadvantages and a description of the future of ERP can be found in Appendix 2.

| ERP system | Advantages | Disadvantages |
|---|---|---|
| | 1. There is one core database, which is used for all business processes → all required data is available at the same time for the whole company and reduction of number of errors (Rizzi and Zamboni, 1999).<br>2. ERP facilitates greater managerial control, faster decision making and reduction of costs (Holland and Light, 1999; Al-Mashari et al, 2003).<br>3. Tangible benefits: inventory reduction, increased productivity, reduction in transportation and logistics costs and improvement in in-time delivery performance (Computer Technology Research Corporation, 1999).<br>4. Intangible benefits: improved visibility of data, improved responsiveness to customers, tighter integration between systems, increased flexibility, global sharing of information (Computer Technology Research Corporation, 1999). | 1.Flexibility of ERP makes the systems complex. Often long implementation phase is needed → lot of time and money (Rizzi and Zamboni, 1999).<br>2. It takes about eight months before the benefits of ERP are recognisable for the company (Al-Mashari et al, 2003). |

Table 2: 'Advantages and disadvantages of ERP'

### Warehouse Management Systems

Warehouse Management Systems are systems that provide real time views on material flows within the warehouse, or in other words, they are tracking and keeping note of the movement and storage of material within a warehouse, facilitating the optimal use of space, labour and equipment (Helo and Szekely, 2005). WMS could be important for inventory management and for order flow, i.e. retrieval orders and traceability (Helo and Szekely, 2005).

WMS might be very valuable for make-to-stock perishable products (Rizzi and Zamboni, 1999). In this case a company can adopt picking policies as first-in, first-out, or fist expiry, first out. The WMS can generate a picking order list based on the picking policy and thereby providing the employees in the warehouse exact instructions about where products are located in the warehouse and which products have to be picked for a specific order. In this case, the abilities of the WMS to identify the location of the products and thereby to trace them are very important.

### Laboratory Information Management System

Laboratory Information Management Systems were created to manage the data and information from laboratory testing (Nakagawa, 1998). One definition of LIMS is difficult to give, because the definition of LIMS depends upon the perception of a person or organisation (Nakagawa, 1998). According to Thurston (2009), the aims of LIMS are to manage and control the quality assurance, organise and store analytical data, and to facilitate the conversion of data into information. A characteristic of LIMS is that the laboratory data and information are saved in an electronic database, so that data can be easily tracked, sorted and retrieved (Grauer, 2003). Nakagawa (1998) states that depending on the perception of the organisation, LIMS could be valuable for quality assurance. Due to the storage of laboratory data and analysis on this in a database, which is accessible for the whole organisation, the recognition of problems in a product could be fast and also spread among the company. In this way, a company is able to track and trace the products, that contain the problem, in an effective way.

## *Step 5 Communication of traceability data*

According to Luning and Marcelis (2009), traceability involves connecting the physical flow of products with the associated information flow. This information flow should be continuous

throughout the supply chain and therefore each actor in the supply chain has to communicate the pre-defined traceability data to the next actor. There are different data systems for communication that can be used to guarantee a continuous information flow, for example e-mailing, electronic data interchange software (EDI) and eXtensible Markup Language (XML). E-mail, EDI software and XML will be discussed below.

To be able to communicate the traceability data throughout the supply chain, a common and standardised infrastructure is needed to facilitate this. The codes of the European Article Number Association (EAN) and the Uniform Code Council (UCC), which were described in step 2 '*Identify unique identity of products, logistic units and locations*', could be used to create a common and standardized infrastructure.

### E-mail

According to Gunasekaran et al (2002), e-mail is the exchange of computer-created and computer-stored messages via a telecommunications network. The usage of e-mail to communicate is seen as a fast, flexible, simple and cost-effective way to communicate (Gunasekaran et al, 2002). However, when the e-mail volume becomes very large, it can inhibit a person's productivity. Then other communication methods might be a better solution.

### Electronic Data Interchange

Electronic Data Interchange is a communication standard that enables the electronic transfer of routine documents between business partners (Turban and Volonino, 2012). EDI adapts the format of these routine documents according to standards upon which is agreed. Several reviews (FSA-UK, 2002) and studies (IDEA Project Team, 2001) state that EDI might be one of the best tools to use for the communication of traceability data.

There are two different major standards for data exchange with EDI, namely the UN/EDIFACT and the ANS ASC X12 (Ayalew et al, 2006). Each standard consists of a set of internationally agreed standards, directories and guidelines for the exchange of data (Ayalew et al, 2006).

### Advantages of using EDI

There are standards for the documentation and exchange of data with EDI, which facilitates the exchange of traceability data between different actors in the supply chain (Gunasekaran et al, 2002). Furthermore, large volumes of data can be exchanged due to this standards, when there is an adequate bandwidth present (Gunasekaran et al, 2002).

### Disadvantages of using EDI

The implementation and usage of an EDI system implies high costs (Ayalew et al, 2006). Secondly, many different choices exist regarding EDI. It is possible for example to use EDI in combination with XML, but it is also possible to use EANCOM, which combines EDI with the EAN-UCC numbering system. Ayalew et al (2006) suggest that it might be beneficial when governments and industries try to standardise EDI.

### XML

According to Fawcett et al (2007), Extensible Markup Language is a flexible computer language that facilitates information transfer between a wide range of applications. Turban and Volonino (2012) described XML in a slightly different way, namely as a set of rules and guidelines for describing data that can be used by other programming languages. This makes data sharing possible across the internet.

## 2.7 Conclusion

The question to be answered in this chapter was 'Which elements are important when traceability is implemented order to guarantee the origin and production methods of a food product?'.

Several studies (Leat et al,1998; Van der Vorst, 2004; Hobbs et al, 2005) state that traceability might be valuable for the guarantee of the origin and used production methods of a product. However, Burhr (2003) states that it is dependent on certain characteristics of the supply chain whether the implementation of traceability will be preferred or not. The chain elements that would influence the choice for traceability according to Buhr (2003) are the presence of information asymmetry, the number of suppliers, the frequency of purchasing, task observation, uncertainty about product quality and quantity and the costs of monitoring.

When the supply chain is analysed on these elements and the conclusion is that traceability might be valuable for the chain, a traceability system could be implemented according to the steps identified by Mgonja (2007). These steps identify elements, which are important for the realisation of traceability. The elements can be divided into a traceability strategy and objective and four traceability implementation elements (identification of products, logistic units and locations, capturing and recording of data, data retrieval and link to management, and communication of data) which together form a traceability system.

- In the first step, the traceability strategy and objective need to be identified. According to Van der Vorst (2004), there are three main traceability strategies, namely a compliance-oriented strategy, a process improvement-oriented strategy, and a market-oriented strategy. The traceability objective reflects what the company wants to achieve with the traceability system.
- The second step is to identify the unique identity of products, logistic units and locations. The locations represent the different actors and the roles of the different actors in the chain. After that, the relevant trade items or traceable resource units (TRU) and the logistic units, consisting of trade items, need to be defined. When the definitions of the trade items, logistic units and locations are given, they need to be uniquely identifiable, which could be done by the common used EAN-UCC identifiers.
- The third step involves making decisions about how to capture and record the traceability data. RFID, barcodes and biometrics are widely used technologies for this (Trienekens and Van der Vorst, 2006). Similar to the statement of Trienekens and Van der Vorst (2006), Regattieri (2007) states that barcodes and RFID are the most common used IT tools in practice to create traceability.
- The fourth step is about data retrieval and linking data to management. In this step, the technologies, used for the capturing of traceability data, need to be integrated in the administrative systems. Examples of common used systems are Enterprise Resource Planning systems, Warehouse Management Systems, and Laboratory Information Management Systems.
- The fifth step involves decision making about the communication of the traceability data in the supply chain, so that a continuous information flow in the chain can be realized. Common data systems used for this are e-mail, Electronic Data Interchange, and Extendable Markup Language.

## Chapter 3 'Governance mechanisms, transaction elements and traceability'

In the previous chapter, the importance of traceability for quality assurance was described and the necessary elements to take into account when implementing a traceability system were outlined. These elements were adapted from the research of Mgonja (2007) (see Figure 4). The chosen traceability strategy influences the execution of the other implementation steps. When a market-oriented strategy is chosen, which means that the aim is to realise full traceability throughout the supply chain, the level of traceability will probably be high. This influences the identification of products, logistics units and locations, because then there is a larger probability that the level of identification will be on product level instead of batch level. The strategy will also influence the way in which the traceability data is captured and stored, how it can be retrieved, and the way in which the communication of the traceability data will take place. When a market-oriented strategy is chosen it is more likely that more advanced tools like RFID tags or biometrics are used to capture data. There is also a larger probability that more advanced technologies, like Electronic Data Interchange, will be used to store and communicate the data.

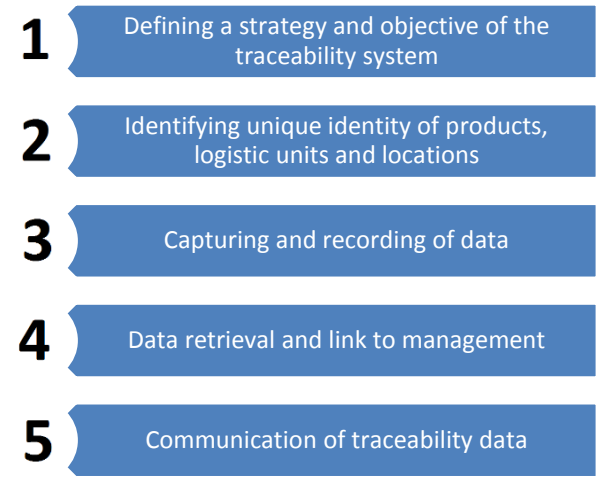


**Figure 4: 'Steps to be taken when implementing traceability', adapted from Mgonja (2007).**

However, not only the traceability strategy will determine the execution of the traceability implementation steps of Mgonja's framework, there are also certain governance mechanisms and transaction elements influencing these governance mechanisms, which will influence this execution and also the traceability strategy itself. A governance mechanism is a way to coordinate the transactions between two parties by formal or informal rule, so it reflects how a chain is organised. All of the elements identified by Buhr (2003) influencing whether traceability is preferred or not have something to do with the organisation of the supply chain (see Figure 2). Therefore, the organisation of a supply chain might influence the decision whether a traceability system will be implemented or not. Next to that, it might also influence how a traceability system will be implemented.

In this chapter important governance mechanisms will be identified and the way in which these governance mechanisms influence the execution of the traceability implementation steps will be described. Furthermore, important transaction elements will be described and their interaction with traceability will be outlined. Therefore, the sub question to be answered is: 'In which ways do governance mechanisms and transaction elements influencing these governance mechanisms in a food supply chain interact with a traceability system and how can a traceability interaction framework be developed based on these interactions?'.

In this study, three different categories of governance mechanisms will be described, namely standards and two governance mechanisms derived from Transaction Cost Economics and Social Network Theory. Transaction Cost Economics focuses more on the formal governance mechanisms between two parties and Social Network theory pays more attention to the informal governance mechanisms. Next to the description of these governance mechanisms, the transaction elements, which are derived from Transaction Cost Economics, will be described. The structure of the chapter is as follows: firstly, a description will be given of each governance mechanism and of the transaction elements. Secondly, the interaction between this governance mechanisms, the transaction elements

and the traceability elements as described by Mgonja will be outlined. After that, one framework will be presented, which summarises the interactions between the traceability elements, the three governance mechanisms and the transaction elements.

## 3.1 Transaction cost economics

Transaction Cost Economics investigates the different possible governance mechanisms between two parties based on the type of transaction that they execute (Williamson, 1979). A governance mechanism is about how the coordination of a transaction is organised. An example of a governance mechanism is coordinating a transaction by using a contract.

A transaction has three critical elements by which it can be characterised. These elements are the following: uncertainty, the frequency by which transactions recur, and the degree to which durable transaction-specific investments are incurred, i.e. asset specificity (Williamson, 1979). However, according to Rindfleisch and Heide (1997), several studies did not find any association between transaction frequency and the established governance mechanism (Anderson, 1985; Anderson and Schmittlein, 1984; Maltz, 1993, 1994; Pilling et al, 1994). Therefore, the effects of the transaction frequency on the governance mechanism as hypothesised by Williamson (1979) are doubtful. In several studies the difficulty of performance measurement is named as an element which might have an important influence on the established governance mechanism (Anderson and Schmittlein, 1984; Wever, 2012).

The interpretation of the three elements will result in different types of transactions. A transaction can be either non-specific, which means that 'faceless buyers and sellers meet for a moment to exchange standardised goods at equilibrium prices', semi-specific, or highly-transaction specific, which means that the transaction is tailored to the special needs of both parties (Williamson, 1979). The type of transaction influences used the governance mechanism by two parties (see Figure 5).

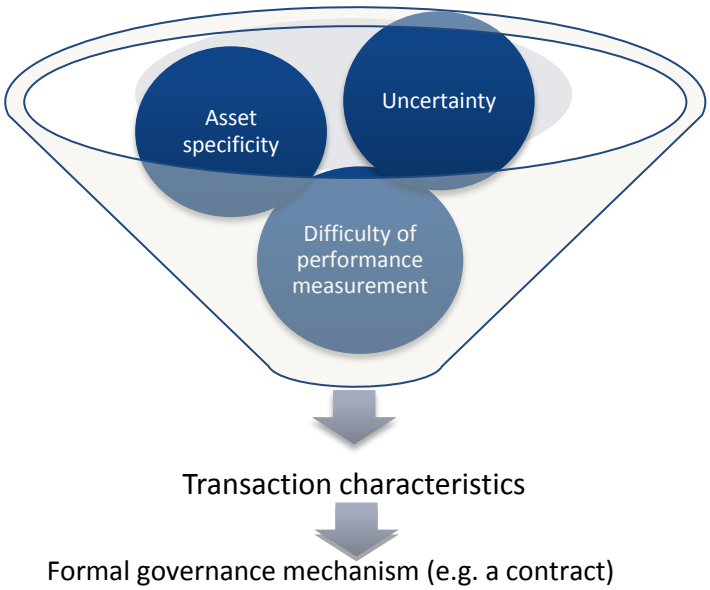


Figure 5: 'Three elements determining the characteristics of a transaction and the governance mechanism'

### *The three elements influencing a transaction: transaction-specific investments*

The first element that influences the characteristics of a transaction are transaction-specific investments or asset specificity. The question that needs to be asked is 'To what extent are transaction-specific, i.e. nonmarketable, expenses incurred?' (Williamson, 1979). In case of large investments that are transaction-specific, which means that the investments are specialised to a

specific transaction, it becomes more difficult for on the one hand the supplier to sell his products to other customers, but also for the buyers to find a different source for their purchases. When two parties invest in particular production machinery that is tailored for them to produce unique products, the two parties become more bounded to each other. It becomes more difficult for both parties to switch to another supplier or buyer, because then they cannot use the machinery anymore.

Williamson (1979) distinguishes the following three types of investments:

- Nonspecific investments, which means that the investment is standardised. The supplier or buyer can easily switch to another partner.
- Mixed investments, which means that the investments are idiosyncratic to a certain extent. Examples are customized equipment or customized raw materials.
- Idiosyncratic investments or asset specificity, which means that these investments are made for a specific transaction between two parties. In this case, it is more difficult for both suppliers and buyers to switch to other parties.

There are four different types of idiosyncratic investments or asset specificity, namely site specificity, physical asset specificity, human asset specificity and dedicated assets (Williamson, 1983). Geographical asset specificity means that the two parties are located close to each other to minimise transportation and inventory costs. The assets in this case are very immobile. Physical asset specificity involves relationship-specific equipment and machinery. Human asset specificity refers to human capital, achieved through specialised training or learning by doing. The dedicated assets refer to relatively large investments that would not have been made outside a particular transaction (see Figure 6).

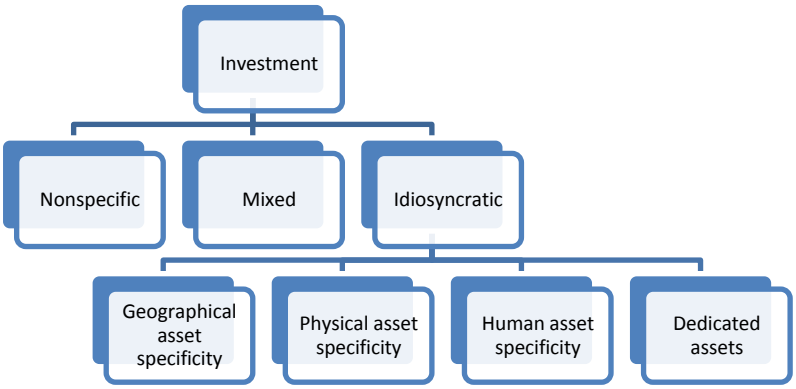


Figure 6: 'Different types of investments'

### *The three elements influencing a transaction: environmental uncertainty*

Uncertainty is the second element that influences the characteristics of a transaction. According to Williamson (1981) and Rindfleisch and Heide (1997), there are two types of uncertainty. The first type is environmental uncertainty, which occurs before a transaction takes place. Environmental uncertainty refers to unanticipated changes in circumstances around a transaction, which means that there are difficulties with modifying agreements to changing circumstances (Rindfleisch and Heide, 1997). Examples of environmental uncertainty are uncertainty about demand or supply and technological developments. The second type of uncertainty is behavioural uncertainty, which occurs after a transaction has taken place. Behavioural uncertainty involves difficulties with verifying whether the other party has complied with the agreement. Another term that is often used for behavioural uncertainty is difficulty of performance measurement (Anderson and Schmittlein, 1984). The effects of environmental uncertainty on the established governance mechanism will be discussed

here, while the effects of behavioural uncertainty will be discussed under the heading 'The three dimensions influencing a transaction: difficulty of performance measurement'.

In different studies mixed results are found about the effect of environmental uncertainty on the established governance mechanism (Klein et al, 1990; Rindfleisch and Heide, 1997). Some studies found that more environmental uncertainty would lead towards a more hierarchical governance mechanism. In a hierarchical governance mechanism, two parties vertically integrate or actively work together, while maintaining their autonomy. According to Williamson (1979), depending on the nature of the transaction, i.e. whether it is specific or standardised, the impact of uncertainty on the governance mechanism differs. When transactions are standardised, uncertainty does not have a big influence on the governance mechanism, because switching to new trading partners is easy (Shelanski and Klein, 1995). However, when a transaction is highly specific, uncertainty has an increasing impact on the governance mechanism. As the degree of uncertainty increases, it becomes impossible to write down every detail about the transaction and the number and importance of adaptations of the contracts will increase. In this case, a hierarchical governance mechanism would be appropriate to overcome this 'write down and adaptation' problem. When the transactions are semi-specific, there are two possibilities. The first possibility is to make the good or service more standardised, so that market governance can be used. The second possibility is to maintain the specified design of the good or service, but to add an elaborated governance mechanism, so that adaptive decision making will be possible (Williamson, 1979). When the amount of uncertainty decreases, there will be a shift in governance mechanism in the opposite direction. In that case, the focus will be more on market contracting (Williamson, 1979). Similar results have been found by John and Weitz (1988); Levy (1985); and Masten et al, (1989).

However, other studies found either a negative effect of environmental uncertainty on the tendency towards a hierarchical governance mechanism (Gatignon and Anderson, 1988; Harrigan, 1986) or a negligible effect (Anderson and Schmittlein, 1984). According to Anderson and Schmittlein (1984) the effect of environmental uncertainty on the governance mechanism is dependent on other transaction-related elements, like the asset specificity.

### *The three elements influencing a transaction: difficulty of performance measurement*

The third element that influences the characteristics of a transaction is the difficulty of performance measurement or behavioural uncertainty. Behavioural uncertainty involves difficulties with verifying whether the other party has complied with the agreement (Rindfleisch and Heide, 1997). According to Anderson (1985), rewarding certain performance via the market mechanism is possible when performance is easy to evaluate. However, when performance cannot be evaluated easily, it is not known what to reward and how much to reward. In this case, using the market mechanism for rewarding might not be efficient. It is possible to reduce the measurement problem by monitoring inputs and using subjective evaluations as the basis of rewarding (Jensen and Meckling, 1976) or by measuring outputs (Eisenhardt, 1985), which implies measurement costs.

As measurement becomes more difficult, the parties involved in a transaction will probably establish a more complex governance mechanism, so that they are better able to accurately measure performance and reward based on real performance (Poppo and Zenger, 2002). Several studies found the same positive effect of behavioural uncertainty on the tendency towards a hierarchical governance mechanism (with a more complex contract) (Gatignon and Anderson (1988); John and Weitz, 1988). The reason for this is that companies try to minimise their costs (Williamson, 1985). A high difficulty of performance measurement will lead to high measurement costs, which can be minimised by establishing a hierarchical governance mechanism like vertical integration.

### *Different types of governance mechanisms based on the transaction elements*

There are three different types of governance mechanisms which can be derived from the three elements influencing a transaction (for an overview, see Figure 7). Next to the transaction elements, past relationships and anticipation of future exchanges also influence the established governance mechanism between two parties (Rindfleisch and Heide, 1997).

- Market governance: Market governance is the main governance mechanism for nonspecific transactions (Williamson, 1979). When transactions are standardised, both parties can easily switch to other parties. Furthermore, market governance is appropriate when the costs of adaptation and performance measurement are low, due to a low level of uncertainty (Rindfleisch and Heide, 1997). When difficulty of performance measurement is low, it is easy to reward the trading partner via the market. Low costs of adaptation means that the environmental uncertainty is low. A low environmental uncertainty makes it possible to write down every detail about the transaction in a contract. This means that market governance is suitable when the asset specificity, the environmental uncertainty and the behavioural uncertainty are all low.

- Trilateral governance: Trilateral governance as a hybrid, i.e. intermediate governance mechanism, is the main governance mechanism for mixed and idiosyncratic transactions (Williamson, 1979). In this case, transaction-specific investments have been made, so both parties want to sustain the relationship for a longer period. Sustaining a relationship is not the aim of market governance, so that does not fit a relationship in which transaction-specific investments have been made. On the other side, a transaction-specific governance mechanism will result in unnecessary high costs. Therefore, trilateral governance as an intermediate governance mechanism fits this case best. Trilateral governance is appropriate when the level of asset specificity is moderate or high (Williamson, 1979) and when the behavioural uncertainty is moderate. The environmental uncertainty is not taken into account, because there is no consensus about its effect on the governance mechanism.

- Transaction-specific governance: Transaction-specific or hierarchical governance is the main governance mechanism for mixed and idiosyncratic transactions (Williamson, 1979). Within the transaction-specific governance, two types of governance mechanism can be distinguished. The first one is the bilateral governance mechanism, which means that the autonomy of both parties is maintained (Williamson, 1979), and the second one is the unified governance mechanism, which means that the two parties vertically integrate. According to Rindfleisch and Heide (1997), moving towards more integration is appropriated when the costs of performance evaluation are high due to high levels of behavioural uncertainty. In this way, the parties are better able to control and monitor the performance of the other party (Eisenhardt, 1985; Oliver and Anderson, 1987). Furthermore, the parties have the possibility to provide long term rewards, which reduces the benefits from opportunism, i.e. self-interested behaviour (Rindfleisch and Heide, 1997), and more corresponding goals can be created, which also reduces opportunism (Williamson, 1975). This makes a transaction-specific governance mechanism appropriate when the asset specificity and the behavioural uncertainty is high (Gatignon and Anderson, 1988; John and Weitz, 1988). There is no consensus about the effect of environmental uncertainty on the governance mechanism, so therefore that dimension is not taken into account here.

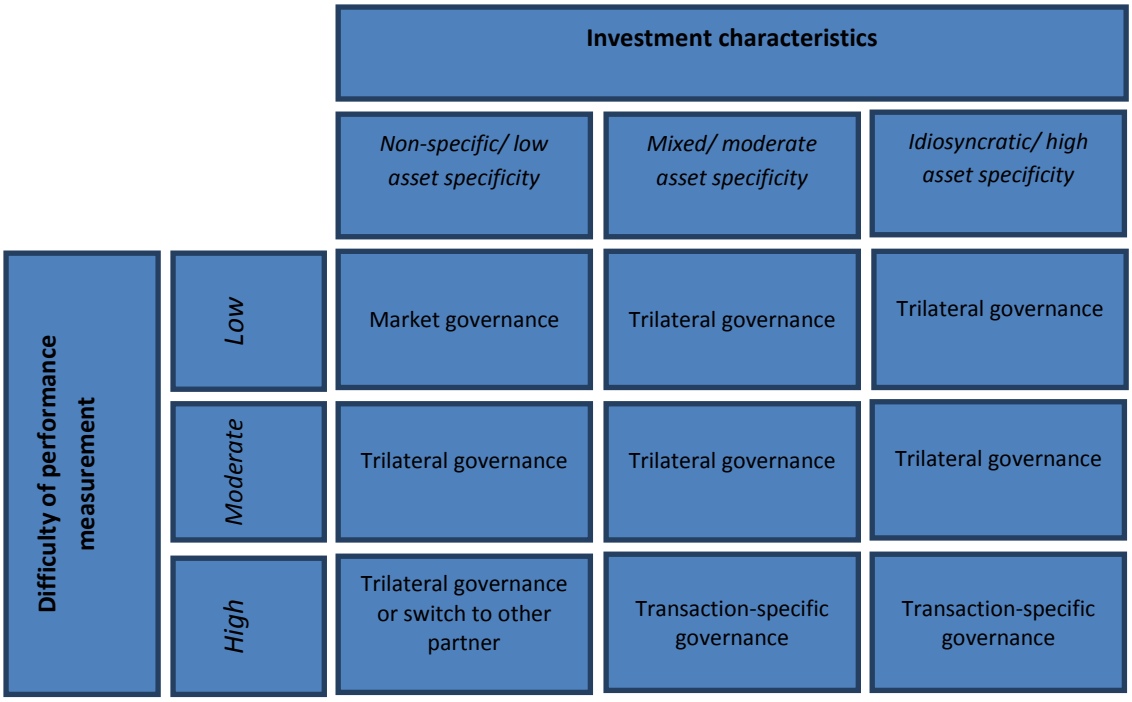


Figure 7: 'Elements of a transaction and the matching governance mechanism'

*Note: environmental uncertainty is not taken into account in this figure, because there is no consensus about its effect on the established governance mechanism.*

Now Transaction Cost Economics will be linked to the traceability elements. It is difficult to link governance mechanisms to the traceability elements, because a governance mechanism is influenced by the transaction elements. Therefore, the focus will be on the interaction between the transaction elements and the traceability elements. The interactions will be described below and an overview can be found in Figure 8.

## 3.2 Transaction Cost Economics and traceability

### *Interaction between traceability strategy and transaction elements ( 1 + 2 )*

The definition of traceability according to the European Union is the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution (EU, 2002). According to Van der Vorst (2004), there are three main traceability strategies, namely the compliance-oriented strategy, the process-improvement strategy and the market-oriented strategy. The compliance-oriented strategy focuses on complying to the rules and regulations. The level of traceability will probably be low. The process improvement-oriented strategy means that a company strives for traceability within the own company to comply with rules and regulations, but also to realise a better return. The third strategy is the market-oriented strategy, which implies full traceability throughout the whole supply chain to create added value. These strategies will have implications for the transaction characteristics. When a compliance-oriented strategy is chosen, which means that a traceability system is implemented because of public standards, so implementation is obligatory, there will not be an effect on the transaction characteristics (Banterle and Stranieri, 2008). However, when a market-oriented strategy is chosen and a traceability system is implemented on a voluntary basis, there might be an effect on the transaction characteristics. According to Banterle and Stranieri (2008), the implementation of a voluntary traceability system might lead to an increase in asset specificity and a decrease in uncertainty throughout the supply chain. The increase in asset specificity is due to an increase in transaction-specific investments needed for the implementation of the

traceability system. The decrease in uncertainty is due to a higher level of transparency in the chain as a result of the traceability system (Hobbs, 2004).

### *Interaction between transaction elements and governance mechanism ( 3 )*

According to Banterle and Stranieri (2008), the implementation of a voluntary traceability system might lead to an increase in performance measurement costs, due to the measurement costs itself and the investments that are needed to implement traceability. Together with the effect on the asset specificity and uncertainty as described above, these differences in transaction characteristics might lead to a different governance mechanism. According to Banterle and Stranieri (2008), there are three different possibilities based on the governance mechanism that the parties had before the implementation of the traceability system. Firstly, when two parties had an oral agreement before the implementation of traceability, there might be a tendency towards more contracted coordination. Secondly, when two parties are already using contracts to coordinate their transactions, different effects on the governance mechanism may occur. Thirdly, when two parties are already vertically integrated, the changes in transaction characteristics will not influence the governance mechanism.

### *Interaction between transaction elements and traceability system ( 4 )*

The transaction characteristics might initiate the implementation of the traceability system. According to Banterle and Stranieri (2008), the human asset specificity and the geographical asset specificity of a transaction as two types of transaction-specific investments might be important factors in determining whether a traceability system will be implemented with a trading partner (see Figure 6). When two parties already have made investments in human capital (trainings, education, etc.), it is more likely that a traceability system will be implemented than in a situation in which these investments have not been made. Furthermore, the geographical closeness of certified suppliers might also positively influence the choice for a traceability system (Banterle and Stranieri, 2008). According to Buhr (2003), the difficulty of performance measurement and the level of environmental uncertainty might also influence the choice for an traceability system (see Figure 2). When the environmental uncertainty and/or the difficulty of performance measurement are high, a traceability system might be preferred.

### *Interaction between traceability strategy and objective and the other traceability elements ( 5 )*

The traceability strategy and objective might also interact with the traceability implementation elements. When a market-oriented strategy is chosen, which means that the aim is to realize full traceability throughout the supply chain, the level of traceability might be high. This influences the identification of products, logistics units and locations, because there is a higher probability that the level of identification will be on product level instead of batch level in this case. The strategy will also influence the way in which the traceability data is captured and stored, how it can be retrieved, and the way in which the communication of the traceability data will take place. When a market-oriented strategy is chosen it is more likely that more advanced tools like RFID tags or biometrics are used to capture data. There is also a larger probability that more advanced technologies, like Electronic Data Interchange, will be used to store and communicate the data. Van der Vorst (2004) states that when a compliance-oriented strategy is chosen, more standardised systems and technologies will be used to gather and exchange information. Furthermore, he states that the level of identification in case of a compliance-oriented strategy will be higher, for example at batch level.

When these interactions are combined into a framework, it could look like this:

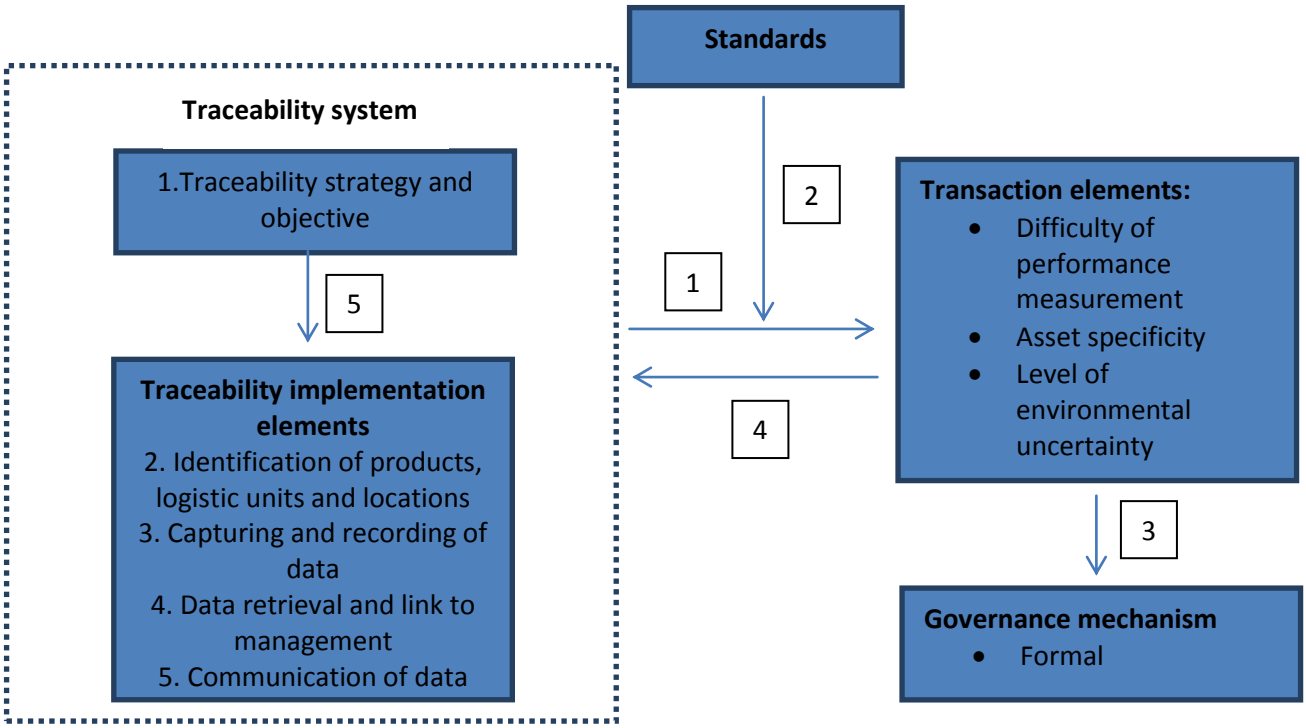


Figure 8: 'Interaction between traceability aspects and transaction elements'

One of the main criticisms on Transaction Cost Economics is that it presents an under socialised view of human motivation and an over socialised view of institutional control (Granovetter, 1985). This means that Transaction Cost Economics assumes that human beings are rational and that their behaviour is self-interested and minimally affected by social relations. The assumption is that the social structure and social relations between people do not have any impact on production, distribution or consumption (Granovetter, 1985). However, next to the formal contracts that have been established between two parties, personal relationships and trust might be also very important for the execution of a transaction (Granovetter, 1985). This idea is missing in Transaction Cost Economics. Several studies found a complementary relationship between formal contracts (Transaction Cost Economics) and relational governance (Poppo and Zenger, 2002; Yu et al, 2006). Therefore, to also take into account the informal side, i.e. the personal relationships between trading partners, the social network theory is outlined.

## 3.3 Social Network theory

According to Lazzarini et al (2001), social network theory emphasises the influence of social structure, i.e. interpersonal relationships and individual positions occupied by agents in a network, on individual or collective behaviour and performance.

Next to formal contracts, which are a result of Transaction Cost Economics, it is also possible to use personal relationships as a governance mechanism. This type of governance is also called relational governance or informal governance. Within relational governance, the creation and promotion of flexibility, solidarity and information exchange norms is very important (Poppo and Zenger, 2002). Flexibility norms facilitate adaptation to unanticipated changes in the environment. Solidarity norms promote joint problem solving. Information exchange norms facilitate joint problem solving and adaptation to unanticipated changes, because these norms create willingness to share private information with the trading partners (Poppo and Zenger, 2002). The result of the three different norms is cooperation between the trading partners.

Trust plays a very important role in relational governance, because it might improve the performance of transactions between organisations (Heide and John, 1990; Saxton, 1997; Zaheer et al, 1998).

Recurring transactions between two parties might provide information about the cooperative behaviour of the other party, from which the parties might derive their judgement about the trustworthiness of the other party (Poppo and Zenger, 2002). Being known as a trustworthy party might lead to rewards, while a reputation as untrustworthy party might lead to punishments by potential trading partners (Poppo and Zenger, 2002).

Next to trust, commitment and reputation are important in relational governance. A party's reputation refers to a characteristic or attribute ascribed to that party by another party (Kollock, 1994). Commitment means that one party binds or dedicates itself to another party. The importance of commitment and reputation is influenced by the amount of uncertainty around a transaction (Kollock, 1994). When there is a high level of uncertainty, commitment will probably be high and the actors will be concerned about their reputation (Kollock, 1994) and vice versa. Anderson and Weitz (1992) link commitment to asset specificity. When the asset specificity is high, i.e. transaction-specific investments have been made, the commitment will probably be high. It works also the other way around: when a party's perception of the other party's commitment is positive, it is more likely that both parties will invest in transaction-specific investments.

Now Social Network theory will be linked to the traceability elements. The interactions will be described below and an overview can be found in Figure 9.

## 3.4 Social Network theory and traceability

### *Interaction between informal governance mechanism and traceability system ( 1 )*

In order to implement traceability, information needs to be shared in the supply chain. Therefore, relational governance in which information exchange norms are created could be beneficial for the realisation of traceability.

### *Interaction between traceability system and informal governance mechanism ( 2 )*

Furthermore, as was stated in the paragraph of Transaction Cost Economics and traceability, implementing a voluntary traceability system might increase the asset specificity. According to Anderson and Weitz (1992), this high asset specificity will lead to higher commitment and thereby it influences the informal governance mechanism.

When these interactions are combined into a framework, it could look like this:

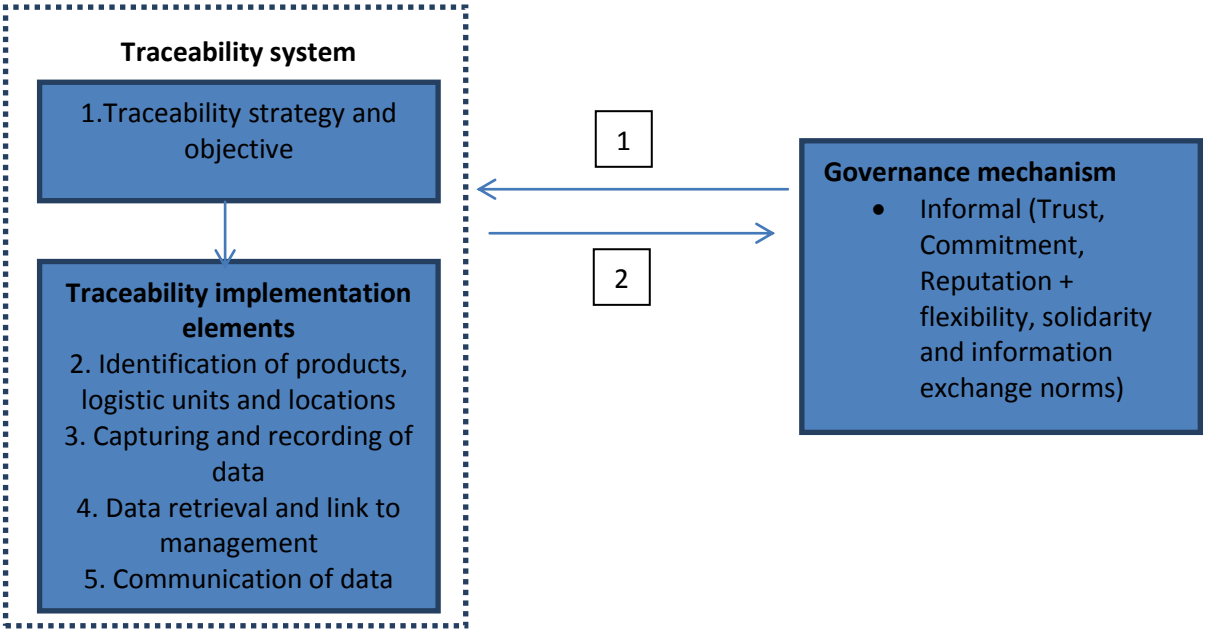


Figure 9: 'Interactions between traceability elements and informal governance mechanism'

*Note: as described in the paragraph 'Interactions between Transaction Cost Economics and traceability', there is an interaction between the traceability strategy and the other traceability implementation elements. To prevent repetition, this interaction is not described here again.*

As described in the introduction of this chapter, now the different types of standards will be outlined, because standards might also function as a governance mechanism.

## 3.5 Standards

According to Giovannucci and Reardon (2001), standards are 'defined parameters which divide similar products into categories and describe them with consistent terms that can be commonly understood by market participants'. In this way, by using standards as certification and as a label, a standard can provide customers and consumers with information about the product (Syahruddin, 2011). Next to the function of creating clarity as described by Giovannucci and Reardon and the function of providing information to customers and consumers (Syahruddin, 2011), standards might also function as a governance mechanism, when there is a third party checking compliance with the standard (Nadvi, 2008). When the actors in a supply chain decide that they want to comply with a particular standard and there is a third party executing audits to check whether the actors really comply to the specifications of the standard, the need for coordination by the companies in the form of for example contracts to check compliance with the standard reduces, because this check is done by the third party. According to Nadvi (2008), this might be the case for product, technical and quality management standards. In this case, a standard reduces the need for coordination by the two parties, because the third party auditing is responsible for the coordination. Therefore, a standard might function as a governance mechanism.

Standards can be classified into different categories based on whether they cover a product or a production process, whether they are private or public, and voluntary or obligatory (Grote and Kirchhoff, 2001). In this study the focus will be on food standards, because the aim is to do research on the interaction between traceability and the characteristics of food supply chains. In food supply chains, it is possible to distinguish between public obligatory standards, private obligatory standards and private voluntary standards (Trienekens and Zuurbier, 2008). These different types of standards will be outlined and examples of each category will be given.

### *Public obligatory standards:*

Public obligatory standards are regulations and laws established by governments, which are thereby made obligatory for companies. Some important public obligatory standards will be outlined below.

#### Codex Alimentarius:

The Food and Agricultural Organisation (FAO) and the World Health Organisation (WHO) established the Codex Alimentarius in 1962 to protect public health and to support balanced food trade relationships. The Codex Alimentarius is a global code that includes several food standards including food hygiene, pesticides residues, contaminants and labelling (Trienekens and Zuurbier, 2008).

#### Good Practices codes: GAP and GMP:

Good Practices codes were established in the 1960's to create clarity about safe and hygienic production procedures (Luning and Marcelis, 2009). The most common codes of Good Practices are Good Agricultural Practices (GAP) and Good Manufacturing Practices (GMP). GAP aims at providing minimum standards for agricultural production and standards (Trienekens and Zuurbier, 2008). Examples of GAP guidelines are about post-harvest handling and transportation, documentation, labeling, complaint and recall management, pesticides management. GMP codes for food products aim at assuring minimum standards for the processing and storage of food products (Luning and Marcelis, 2009). Examples of GMP guidelines are about employees (education and training, supervision), plant and grounds (sufficient maintenance, plant construction and design to facilitate

sanitary operations and maintenance), sanitary operations and facilities (cleaning of equipment and facilities, storage of cleaning materials, hand-washing facilities, water supply), equipment, processes and controls, etcetera (Luning and Marcelis, 2009).

The Good Practices codes are originally on a voluntary basis, but some guidelines have been included in regulations, which have made them obligatory (Luning and Marcelis, 2009).

### Hazard Analysis of Critical Control Points (HACCP):

HACCP is a systematic approach to the identification, evaluation and control of those steps in food manufacturing, which are critical to product safety (Trienekens and Zuurbier, 2008). The aim of HACCP is to assure the safety of a food product by prevention instead of inspection and HACCP provides some principles to companies to achieve this (Luning and Marcelis, 2009). HACCP identifies risks in the production process, which might lead to unacceptable or irreversible changes in the safety of a product, and it designs measurements to reduce those risks. In 1993, the European Union included HACCP in their legislation, which made HACCP obligatory for all companies in the agri-food chain in the EU member states.

### ISO standards:

ISO standards are international standards that focus on achieving standardisation and preventing technical trade barriers throughout the world (Trienekens and Zuurbier, 2008). The ISO standards are voluntary, just like the Good Practices codes, but some standards have been included in regulation, which have made them obligatory (Luning and Marcelis, 2009). Companies can be certified against the standards provided by ISO. The ISO 9000 and ISO 9000:2000 series provide guidelines for quality management and quality assurance. More information about these ISO series can be found in Appendix 3.

### EU laws and regulations:

The European Union has some laws and regulations on food safety and traceability. An important regulation is the Directive 2001/95/EC on General Product Safety. This law identifies aspects of product safety to which companies have to comply, for example that only safe products are allowed to be placed in the market, that producers should be informed about the risks of the products they produce, that companies should be able to effectively inform customers about these risks and that effective recall management is possible when something is wrong, and that companies should be able to trace the origin of products. Another important law is the Regulation 178/2002 on Food Safety. According to ECR (2004), this law gives accurate definitions of for example traceability and it provides the strictest requirements in terms of consumer safety. This regulation defines how companies should ensure traceability, namely that a company should be able to track and trace their products one step backward and one step forward. Furthermore, it states that the companies are responsible for the food, feed and products that they supply to the market, and that the European Food Safety Authority is allowed to demand information to companies. The regulation is applicable to products imported to the European Union and exported out of the European Union.

National governances probably established additional laws and regulations on food safety and traceability, but these will not be outlined here. The Codex Alimentarius, Good Practices Codes, HACCP, ISO and EU law and regulations will act as a basis for these national regulations.

### *Private obligatory standards:*

Private obligatory standards are not made mandatory by governments, but by the companies in a sector. These standards function as access requirements to which the companies in the sector have to comply (García Martinez and Poole, 2004). There is a trend towards the usage of private food standards (Frohberg et al, 2006; Trienekens and Zuurbier, 2008). According to Vellema and Boselie (2003), private food safety standards have four important aims, namely

- to improve supplier standards and consistency, and to avoid product failure
- to eliminate multiple audit of food suppliers and manufacturers through certification of their processes
- to support consumer and retailer objectives by transferring their demands to parties upstream in the chain
- to be able to provide concise information about production processes in case of incidents.

According to Trienekens and Zuurbier (2008), Eurep-GAP, the British Retail Consortium (BRC) and Safe Quality Food (SQF) are three world-wide used private standards. Next to Eurep-GAP, BRC and SQF, Luning and Marcelis (2009) also identified the Global Food Safety Initiative (GFSI) as an important private standard. Therefore, these standards will be described below.

### BRC (British Retail Consortium)

The British Retail Consortium includes a food safety standard established by British retailers in 1998 (Trienekens and Zuurbier, 2008). The main reason for the retailers to design this standard was to create uniformity. Before 1998, every retailer had its own standards and employees who did inspections at suppliers whether they complied with the standards, which resulted in high costs. By creating one uniform food safety standard and by making a certified inspection organisation responsible for the inspections, clarity was created and a reduction in costs could be realised.

The BRC includes more than only a food safety standard, it also pays attention to a quality management system, standards about facilities and equipment, product and process control, and personnel (Luning and Marcelis, 2009). According to Trienekens and Zuurbier (2008), BRC is based on the principles of HACCP. BRC is focused at the companies in the manufacturing stage of the supply chain (García Martinez and Poole, 2004).

### Global-GAP

The Global-GAP is an organisation of large European retailers and purchase organisations originally established as Eurep-GAP in 1999. Global-GAP contains norms to guarantee environmental-friendly, safe and high-quality products (Trienekens and Zuurbier, 2008). The focus of Global-GAP is on food safety, human resource management and environmental measurements at the companies within the agricultural production (García Martinez and Poole, 2004) and the aim is to create transparency. According to Trienekens and Zuurbier (2008), the major disadvantages of Global-GAP are that there is no uniform certification scheme and that national legislation is taken as a starting point, which differs between countries. Typical Global-GAP requirements include traceability, the collection of data about activities, environmental issues and working circumstances.

### GFSI ( Global Food Safety Initiative)

The Global Food Safety Initiative was established in 2000 by international retailers, who aimed at improving food safety, ensuring consumer protection, gaining consumer trust, setting clear requirements for food safety schemes and reducing costs (Luning and Marcelis, 2009). The GFSI was established as an addition and complement to the Eurep-GAP (García Martinez and Poole, 2004). The GFSI consists of a requirements against which other food safety standards can be benchmarked. This benchmarking will be executed by a third party and when the result of benchmarking is successful, the standard is approved. The GFSI already approved among others the British Retail Consortium, the International Food Standard and the Safe Quality Food.

### SQF (Safe Quality Food)

The Safe Quality Food standard was established in Australia in 1995, aiming at ensuring food safety along the whole supply chain. SQF is based on the principles of HACCP, ISO 9000 standards and quality management systems (Luning and Marcelis, 2009). SQF provides requirements for a food quality management system, which are needed to identify safety and quality risks and to monitor

control measures (Luning and Marcelis, 2009). The SQF consists of a standard for the primary production sector, i.e. agriculture, and a standard for the manufacturing and service companies. According to Trienekens and Zuurbier (2008), SQF is internationally well accepted.

### *Private voluntary standards:*

Private voluntary standards can be used by companies to differentiate themselves in the market. According to Fulponi (2006), there is a movement in the food sector towards an increase in the usage of private voluntary standards regarding products and process characteristics. This movement is among others driven by the increasing influence of the society on governments and companies on issues of the food system, and by the increased market concentration and buying power. It is becoming important to assure the quality of a product in order to create consumer loyalty and increase market shares (Fulponi, 2006).

There are many different private voluntary food standards. A few well known examples are Fair Trade (Max Havelaar in the Netherlands), EKO, and IKB in the meat sector. There are also specific standards about traceability in the food supply chain, like The Fresh Produce Traceability guidelines. The Fresh Produce Traceability guidelines, as established in 2001, provide guidelines for tracking and tracing of fresh products by using the EAN-UCC barcoding and numbering system (see chapter 2 'Traceability', paragraph on the identification of products, logistic units and locations). The execution of the guidelines of the Fresh Produce Traceability is voluntary. The aim of the FPT guidelines is to provide an uniform approach to traceability of fresh products (García Martinez and Poole, 2004).

There are several interactions between the different types of standards, functioning as a governance mechanism, and the traceability elements. These interactions will be described below and summarised in a framework (see Figure 10).

## 3.6 Interactions standards and traceability

### *Interaction between traceability strategy, transaction elements and standards (1+2)*

There is an effect of the traceability strategy on the transaction elements and Banterle and Stranieri (2008) found a relationship between standards and this effect. When a traceability system is implemented in reaction to public obligatory standards, which means there is a compliance-oriented strategy, there only might be limited effects on the characteristics of a transaction. However, when a traceability system is implemented as a consequence of private standards, there might be an effect on the transaction characteristics. The implementation of a traceability system in this case might lead to an increase in transaction-specific investments, a decrease in uncertainty and an increase in performance measurement costs.

### *Interaction between standards and traceability strategy(3)*

The existence of particular obligatory standards might influence the traceability strategy. Due to the EU legislation on traceability, which states that every company should be able to track and trace their products one step backward and forward, companies have to implement traceability. When a traceability system is implemented only in reaction to this legislation, the chosen traceability strategy will be a compliance-oriented strategy.

### *Interaction between standards and traceability implementation elements (4)*

A standard might not only influence the traceability strategy, it might also influence the implementation elements of traceability. Certain standards provide guidelines for the implementation of traceability. For example the Fresh Produce Traceability guidelines provide information on how the products need to be identified, namely by the use of EAN-UCC codes.

### *Interaction between standards and transaction elements ( 5 )*

In a particular standard, guidelines and requirements are identified. Private voluntary standards might have higher requirements for the products for which the company wants to use the standard. To comply with the standard, specific investments in for example human capital or specific systems might be needed. In this way, a standard might increase the asset specificity in order to meet the requirements of the standard.

### *Interaction between transaction elements and standards ( 6 )*

When there is a high asset specificity, standards might safeguard these investments. The same holds for the difficulty of performance measurement. When the difficulty of performance measurement is high, among others the standard might function as a safeguard. By using a standard which has a third party auditing whether the company is indeed complying to the requirements of the standard, the third party is safeguarding the transaction-specific investments and the actual performance.

When these interactions are combined into a framework, it could look like this:

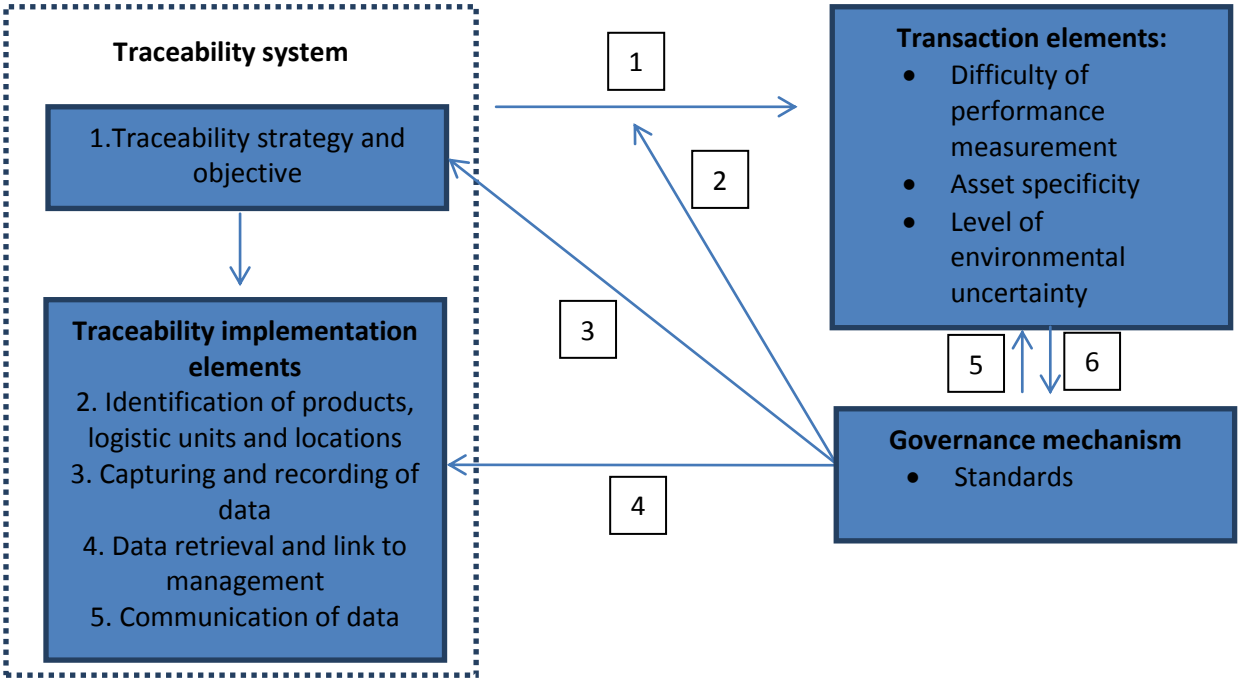


Figure 10: 'Interaction between traceability elements and standards'

*Note: as described in the paragraph 'Interactions between Transaction Cost Economics and traceability', there is an interaction between the traceability strategy and the other traceability implementation elements. To prevent repetition, this interaction is not described here again.*

## 3.7 Conclusion

The question to be answered in this chapter was 'In which ways do governance mechanisms and transaction elements influencing these governance mechanisms in a food supply chain interact with a traceability system and how can a traceability interaction framework be developed based on these interactions?'. As described in this chapter, there are several interactions between traceability elements, transaction elements, informal governance and standards. When these interactions are combined, one framework can be created (see Figure 11).

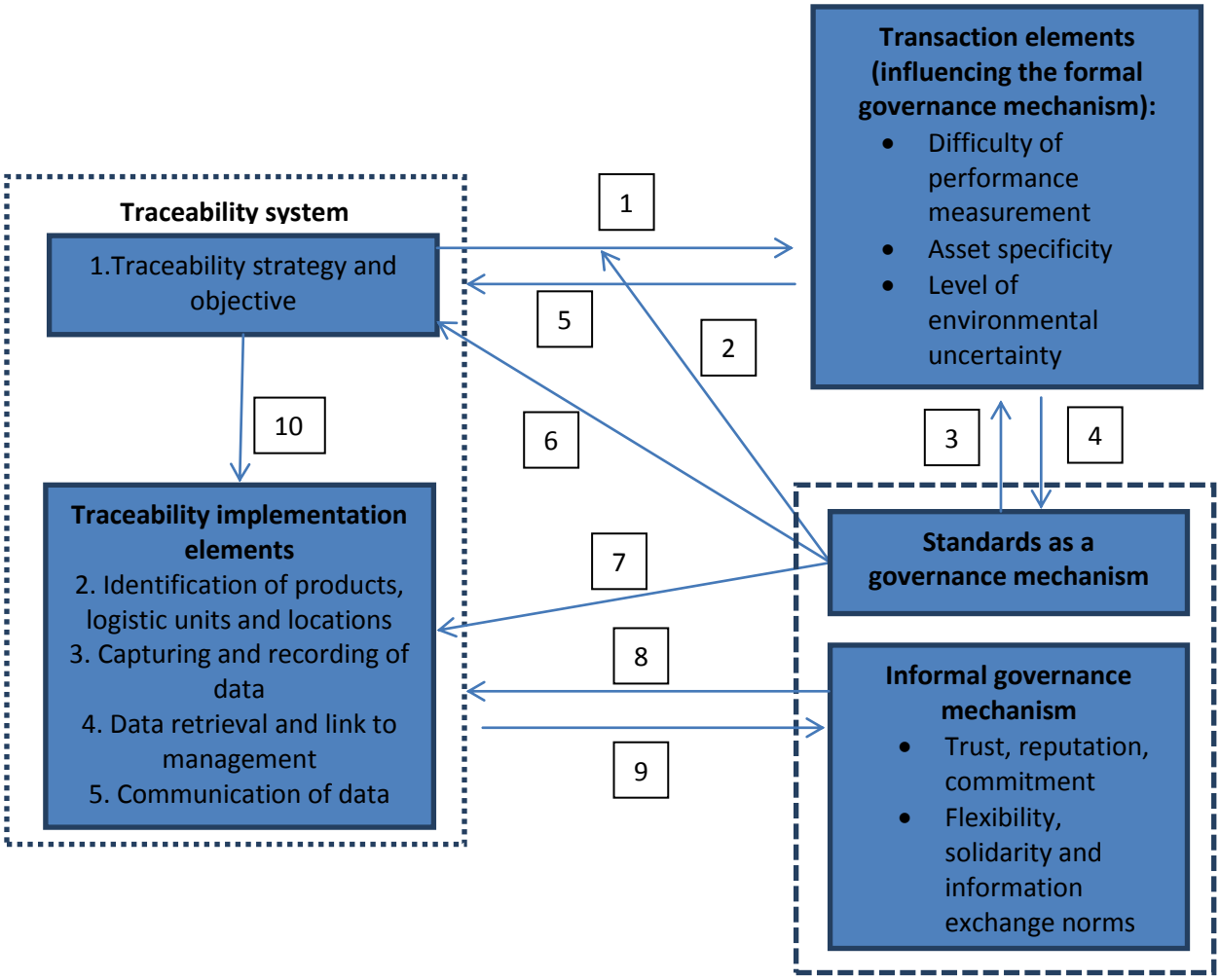


Figure 11: 'Interactions between traceability elements, transaction elements and governance mechanisms'

### *Explanation of interactions:*

### *Interaction between traceability strategy and transaction elements ( 1 + 2 )*

According to Van der Vorst (2004), there are three main traceability strategies, namely the compliance-oriented strategy, the process-improvement strategy and the market-oriented strategy. These strategies will have implications for the transaction characteristics. When a compliance-oriented strategy is chosen, which means that a traceability system is implemented because of public obligatory standards, there will not be an effect on the transaction characteristics (Banterle and Stranieri, 2008). However, when a market-oriented strategy is chosen and a traceability system is implemented on a voluntary basis, there might be an effect on the transaction characteristics. The effect might be an increase in asset specificity and a decrease in uncertainty throughout the supply chain. The increase in asset specificity is due to an increase in transaction-specific investments needed for the implementation of the traceability system. The decrease in uncertainty is due to a higher level of transparency in the chain as a result of the traceability system (Hobbs, 2004).

So there might be an effect of the chosen traceability strategy on the transaction elements, but this effect is influenced by the type of standard in reaction to which the traceability system is implemented.

### *Interaction between standards and transaction elements ( 3 )*

In a particular standard, guidelines and requirements are identified. Private voluntary standards might have higher requirements for the products for which a company wants to use the standard. To comply with the standard, specific investments in for example human capital or specific machinery might be needed. So a standard might increase the asset specificity in order to meet the requirements of the standard.

### *Interaction between transaction elements and standards ( 4 )*

When there is a high asset specificity, standards might safeguard these investments. The same holds true for the difficulty of performance measurement. When the difficulty of performance measurement is high, among others the standard might function as a safeguard. By using a standard that has a third party responsible for auditing whether the company is indeed complying to the requirements of the standard, the third party is thereby safeguarding the transaction-specific investments and the actual performance.

### *Interaction between transaction elements and traceability system ( 5 )*

The transaction characteristics might influence the implementation of the traceability system. According to Banterle and Stranieri (2008), the human asset specificity and the geographical asset specificity of a transaction as two types of transaction-specific investments might be important factors in determining whether a traceability system will be implemented with a trading partner (see Figure 6). When two parties already have made investments in specific trainings and education, it is more likely that a traceability system will be implemented than in a situation in which no investments have been made. Furthermore, the geographical closeness of certified suppliers might also positively influence the choice for a traceability system (Banterle and Stranieri, 2008). According to Buhr (2003), the difficulty of performance measurement and the level of environmental uncertainty might also influence the choice for an traceability system (see Figure 2). When the environmental uncertainty and/or the difficulty of performance measurement are high, a traceability system might be required.

### *Interaction between standards and traceability strategy ( 6 )*

The existence of particular obligatory standards might influence the strategy of a traceability system. Due to EU legislation on traceability, which states that every company should be able to track and trace their products one step backward and forward, companies have to implement traceability. When a traceability system is implemented only in reaction to this legislation, the chosen traceability strategy will be a compliance-oriented strategy.

### *Interaction between standards and traceability implementation elements ( 7 )*

A standard might also influence the implementation of the traceability system. Certain standards provide guidelines for the implementation of traceability. For example the Fresh Produce Traceability guidelines provide information on how the products need to be identified, namely by the use of EAN-UCC codes.

### *Interaction between informal governance mechanism and traceability system ( 8 )*

In order to implement traceability, information needs to be shared in the supply chain. Therefore, relational governance in which information exchange norms are created could be beneficial for the realisation of traceability.

### *Interaction between traceability system and informal governance mechanism ( 9 )*

Implementing a voluntary traceability system might increase the asset specificity (Banterle and Stranieri, 2008). According to Anderson and Weitz (1992), this high asset specificity might lead to higher commitment and thereby influencing the informal governance mechanism.

### *Interaction between traceability strategy and traceability implementation elements(* 10 *)*

The traceability strategy and objective might interact with the traceability implementation steps. When a market-oriented strategy is chosen, which means that the aim is to realize full traceability throughout the supply chain, the level of traceability might be high. This influences the identification of products, logistics units and locations, because there is a higher probability that the level of identification will be on product level instead of batch level in this case. The strategy will also influence the way in which the traceability data is captured and stored, how it can be retrieved, and the way in which the communication of the traceability data will take place. When a market-oriented strategy is chosen it is more likely that more advanced tools like RFID tags or biometrics are used to capture data. There is also a larger probability that more advanced technologies, like Electronic Data Interchange, will be used to store and communicate the data.

# Chapter 4 'Traceability in the cocoa - chocolate chain'

## 4.1 Choice for the cocoa-chocolate supply chain as a case study

As described in the introduction, the developed interaction traceability framework is applied to a particular supply chain as a case study to test the validity of the interaction found in literature. There were two main reasons to use the cocoa-chocolate supply chain for this application, which will be outlined below. According to Syahruddin (2011),there is a trend in the food industry that raw materials are sourced from the southern part of the hemisphere among others due to low cost labour, low cost materials and less strict regulations, whereas the production and processing of the food products takes place in the northern part of the hemisphere. However, the organisation of the supply chain in this way increases the uncertainty about the quality and the difficulty of performance measurement. These effects on the transaction elements increase the importance of checking carefully what the other parties in the supply chain are doing, because malpractices of one party in the chain may damage the reputation of another party. According to Deasy (2002), traceability might be valuable in this case to get information about what the parties in a supply chain produce, where the products are from and how the products are produced. The cocoa-chocolate supply chain is an example of a complex supply chain with multiple actors spread all over the world. The raw materials are grown in less developed countries and the processing is done in developed countries in the northern hemisphere. Therefore, traceability might be valuable in this complex supply chain, because of the spread of the actors of the supply chain around the world. This makes the cocoa-chocolate supply chain an interesting supply chain to apply the developed framework to. Furthermore, several studies have already been done about how the cocoa-chocolate supply chain is set up (Fowler, 2009; Syahruddin, 2011) and about traceability possibilities in this supply chain (Syahruddin, 2011). This was an important prerequisite for the choice for a particular supply chain to apply the framework to, since the case study would be limited due to time constraints.

In this chapter, the developed traceability framework will be applied to the cocoa supply chain by using information from scientific literature and by interviewing some companies that are part of the cocoa supply chain. The question to be answered is 'How is the cocoa - chocolate supply chain set up and what is the result of the application of the traceability interaction framework to this supply chain?'.

## 4.2 Cocoa – chocolate supply chain

In this paragraph, a description of the cocoa-chocolate supply chain will be given to answer the question how the supply chain is set up.

### *How is the cocoa – chocolate supply chain set up?*

The cocoa supply chain starts with the cocoa farmers (see Figure 12). According to Fowler (2009), cocoa is cultivated around the equator, namely up to 20° north and 20° south from the equator in three main growing areas: West Africa, South East Asia and Latin America. There are seven cocoa producing countries which together produce 90% of the total amount of cocoa that is produced in the world. Côte d'Ivoire is the largest cocoa producing country, accounting for 40% of the total cocoa production, followed by Ghana, Indonesia, Nigeria, Cameroon, Brazil and Ecuador (Fowler, 2009). The demand for cocoa is increasing (Syahruddin, 2011) and is expected to keep rising in the future (Fowler, 2009).According to Fowler (2009), 90% of the world's cocoa is grown at small farms, at which multiple crops are cultivated by using labour-intensive methods.

Usually, the cocoa farmers sell their cocoa to local collectors or cooperatives, who collect all cocoa beans of local farmers and sell the cocoa in their turn to local traders, or the cocoa farmers sell the cocoa directly to a local trader (Fowler,2009; Syahruddin, 2011). The local traders can choose between delivering the cocoa beans to local processors or delivering to exporters (See Figure 12). Via the local processors and local manufacturers the cocoa beans are processed, then the overseas processors produce the other needed ingredients for the chocolate. The chocolate manufacturers produce the chocolate out of the cocoa beans and other ingredients. When local traders sell the cocoa beans to exporters, the exporters sell the cocoa beans to overseas buyers. These overseas buyers sell the cocoa beans to chocolate manufacturers, where the whole processing of the cocoa beans and the chocolate takes place. The chocolate manufacturers deliver the finished chocolate products to merchandisers. Merchandisers are responsible for tasks like branding, licensing and the delivery of the chocolate products to the retailers. The retailers sell the chocolate products to the consumers, who are the last actors of the supply chain (Syahruddin, 2011).

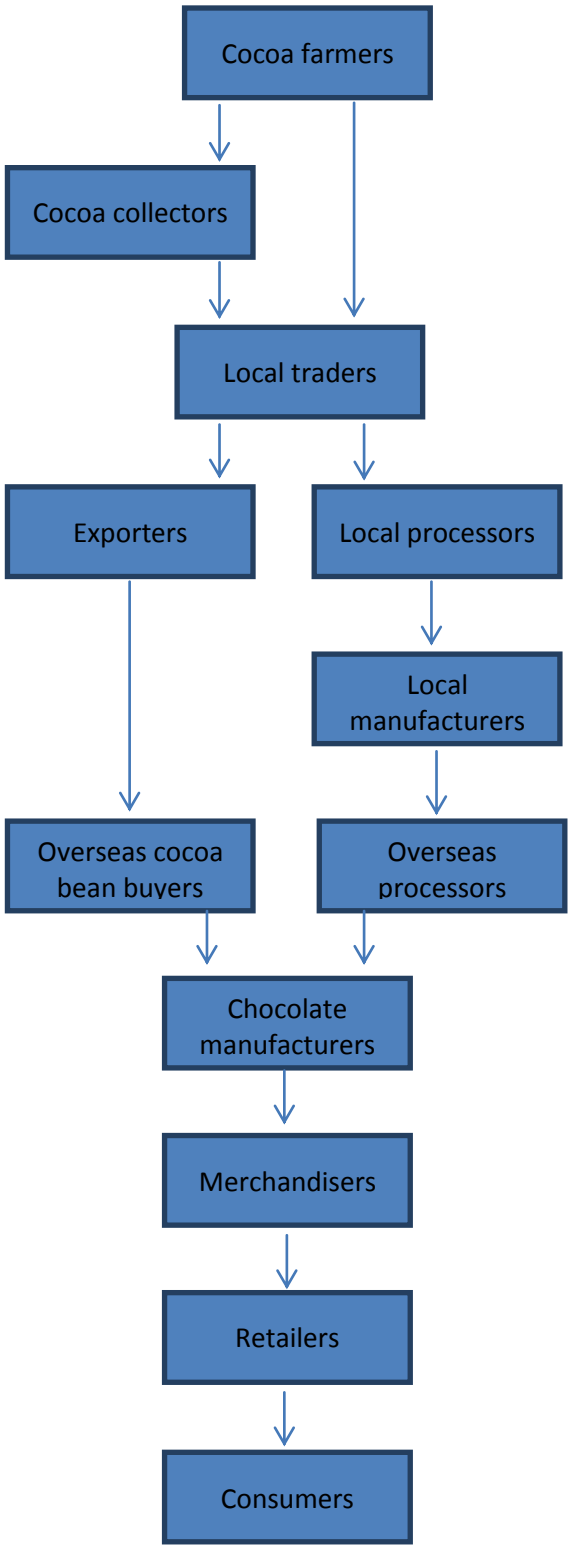


Figure 12: 'Overview of the cocoa-chocolate supply chain', based on Syahruddin, 2011'

### 4.3 Application of the traceability framework to the cocoa-chocolate supply chain

As described above, the developed traceability interaction framework will be applied to the cocoa-chocolate supply chain to test its validity. The main reasons to choose the cocoa-chocolate supply chain as a case study for this application were that traceability might be valuable, but a challenge in this long supply chain and that several studies already have been done about the cocoa-chocolate supply chain. The question to be researched is whether the interactions found in the literature can be recognised in the cocoa-chocolate supply chain by using information from practice. The data are the result of two interviews conducted with a company in the cocoa-chocolate supply chain and a NGO which is involved in the governance of the cocoa-chocolate supply chain.

The interviewed company processes liquid chocolate into chocolate products of their own brand and for private labels. There are two main suppliers of this liquid chocolate, namely Cargill and Barrie Callebaut. The cocoa beans used for the liquid chocolate are sourced from West Africa and Latin America. The chocolate products are delivered to retailers in the Netherlands and Europe. The company complies to the regulations on traceability (EU Regulation 178/2002) of the General Food Law which implies tracing one step back

and one step forward. Complying to this legislation is realised by using product-codes, from which it can be derived from which chocolate the product was made and by which supplier this chocolate was delivered and to which customer the product was delivered. A part of the products of the company complies to Fair Trade and UTZ certified cocoa standards. The liquid chocolate used for these products are also supplied by Cargill and Barrie Callebaut. See Appendix 1 for a summary of the interview with this company.

The second interview was conducted with non-governmental organisation Oxfam Novib. Oxfam Novib has a lot of knowledge of different supply chains, among other the cocoa supply chain. The NGO strives for transparency in these supply chains and better working and living conditions for the farmers in developing countries.

### *Standards*

The main standards that exist in the cocoa-chocolate supply chain are EU Organic farming, Fair Trade, Rainforest Alliance and UTZ certified (see Figure 13).

#### EU organic farming

In 2010, the European Union introduced the standard in order to create one clear standard for organic products in the EU (European Commission, 2013). The requirements of the standards involve responsibly usage of energy and natural resources and usage of biological crop protection and fertilising. These requirements are consistent with the requirements of the Dutch EKO standard. The standard is applicable to organic products within the European Union and for products that are imported in the EU. Each EU-country has its own organisation that is responsible for the certification and auditing of the standard. In the Netherlands, this is done by Skal.


Figure 13: 'Standards in the cocoa supply chain'

#### Fair Trade

As the name already says, Fair Trade is committed to fair trade for farmers in developing countries. The requirements of the Fair Trade standards established by Fair Trade International involve a minimum price for farmers, an additional payment above the world market price, payment at the beginning of the harvest to prevent payment difficulties of the farmers and prolonged trading relationships to assure that farmers can sell their products (Fair Trade Max Havelaar, 2013). The FLO-Cert is responsible for the certification and auditing of producing companies and traders and for checking whether the products comply to the requirements. There are national organisations that collaborate with Fair Trade International, for example Max Havelaar in the Netherlands. Max Havelaar is responsible for the marketing of the Fair Trade standard, the certification, controlling and product development.

#### Rainforest Alliance

The Rainforest Alliance label among others assures that cocoa farmers comply to the Sustainable Agriculture Network (SAN) standards, which include safe and dignified working conditions and protection of wildlife and habitats (Rainforest Alliance, 2013). The SAN is a group of non-profit conservation organisations, that established social, economic and environmental criteria. The

compliance of farmers to the standards is assured by farm management and traceability system standards. The RA-Cert is responsible for the auditing and certification.

### UTZ Certified

The UTZ Certified standard strives for sustainability and better opportunities for coffee, tea and cocoa farmers and their families. The Codes of Conduct of UTZ define requirements about good agricultural practices, safe and healthy working conditions, no child labour, protection of the environment and traceability from the raw material to the retailer (UTZ Certified, 2013). UTZ developed traceability programs for palm oil and cotton. The auditing is yearly done by independent third parties.

Now the validity of all interactions of the traceability interaction framework (see Figure 14) will be described. Firstly, a short summary will be given of the interactions found in the literature and after that, the results from the cocoa-chocolate supply chain will be described.

### *Interaction between traceability strategy and transaction elements ( 1 + 2 )*

In the literature, it was found that the chosen traceability strategy might have implications for the transaction elements. When a compliance-oriented strategy is chosen, which means that traceability is implemented because of public obligatory standards, there will not be an effect on the transaction characteristics (Banterle and Stranieri, 2008). However, when a market-oriented strategy is chosen and a traceability system is implemented on a voluntary basis, there might be an effect on the transaction characteristics. The effect might be an increase in asset specificity and a decrease in uncertainty throughout the supply chain (Banterle and Stranieri, 2008).

The company in the cocoa-chocolate supply chain, which was interviewed, had a compliance-oriented traceability strategy. The company did not made very big investments to realise the traceability system, so there was no effect on the asset specificity. The company neither recognised a change in the amount of environmental uncertainty or in the amount of behavioural uncertainty. This is consistent with the interaction that was based on the literature, because when a company has a compliance-oriented strategy, no effect on the transaction elements could be recognised. Unfortunately, it was only possible to do only one interview with a company from the cocoa-chocolate supply chain. Therefore, the effect of a market-oriented traceability strategy on the transaction elements could not be studied.

### *Interaction between standards and transaction elements ( 3 )*

Private voluntary standards might have higher requirements for the products for which the company wants to use the standard. To comply with the standard, specific investments in for example human capital or specific systems needed for traceability might be needed. Therefore, a standard might increase the asset specificity in order to meet the requirements of the standard.

According to Oxfam Novib, investments are needed when a supply chain wants to comply to a particular standard. Technical investments, like computers, computer systems and housing, and social investments need to be made. The social investments involve education, teaching farmers how to read and how to write, trainings in for example bookkeeping, how to use computers, and how to gather and store data. There are investments needed in the beginning to comply to the requirements of the standard, which are often partly paid by the supply chain itself and partly by donations from for example governments. The costs of maintaining compliance to the standard (the costs of compliance) need to be paid completely by the supply chain itself. The cocoa farmers need to have extra income to be able to pay these costs of compliance.

The interviewed company itself did not made any extra investments for the usage of the private voluntary standards (UTZ, Fair Trade, EU organic farming). However, the suppliers of the certified

liquid chocolate, namely Cargill and Barrie Callebaut, probably made some investments. According to Oxfam Novib, these big international cocoa traders often cooperate with farmer cooperatives. These international cocoa traders invest in cooperatives by for example providing trainings to them. In this way, they want to establish a prolonged trading relationship. Therefore, it is likely that specific investments were needed to comply with a particular standard, which is consistent with the literature, but that these investments were done by different actors in the chain than the interviewed company. By the usage of audits executed by the auditors of UTZ, Fair Trade and EU Organic farming at the suppliers, the interviewed company assures that the delivered chocolate is really certified.

### *Interaction between transaction elements and standards (4)*

It might be that by using a standard, for which a third party is auditing whether the company is indeed complying to the requirements of the standard and thereby the third party is safeguarding the transaction-specific investments and the actual performance.

The company in the cocoa-chocolate supply chain recognised this effect for its UTZ certified products, so this result is conformable with the interaction found in literature. Oxfam Novib also recognises this effect. According to Oxfam Novib, the compliance with standards, or in other words the actual performance, is checked by external auditors. These audits are done yearly and during an audit, the auditors check the books and information which is stored in it and they visit the farmers. The audits are however not always completely reliable, sometimes things are overlooked or not recognised.

### *Interaction between transaction elements and traceability elements (5)*

The transaction characteristics might initiate the implementation of the traceability system. According to Banterle and Stranieri (2008), the human asset specificity and the geographical asset specificity of a transaction as two types of transaction-specific investments might be important factors in determining whether a traceability system will be implemented with a trading partner (see Figure 6). When two parties already have invested in specific trainings and education, it is more likely that a traceability system will be implemented than in a situation in which these investments have not been made. Furthermore, the geographical closeness of certified suppliers might also positively influence the choice for a traceability system (Banterle and Stranieri, 2008). According to Buhr (2003), the difficulty of performance measurement and the level of environmental uncertainty might also influence the choice for an traceability system (see Figure 2). When the environmental uncertainty and/or the difficulty of performance measurement are high, a traceability system might be required.

This interaction was not visible within the company in the cocoa-chocolate supply chain. The transaction elements did not had a big influence on the implementation of the traceability system. The traceability system of the company was designed in reaction to laws and regulations, which made it obligatory to have a traceability system. It was not the case that the traceability system was designed in cooperation with suppliers and customers of the company, so the duration of the relationship with the suppliers and customers did not had a big influence on the implementation of the traceability system. Furthermore, the traceability system is mainly focused on the company itself and there is no strong cooperation with the other parties in the supply chain. The cooperation with the suppliers and customers of the company is efficient, so that only necessary data for traceability are shared.

### *Interaction between standards and traceability strategy (6)*

The existence of particular obligatory standards might influence the strategy of a traceability system. Due to EU legislation on traceability, which states that every company in a food supply chain should be able to track and trace their products one step backward and forward, companies have to

implement traceability. When a traceability system is implemented only in reaction to this legislation, the chosen traceability strategy will be a compliance-oriented strategy.

The company implemented their traceability system in reaction to the legislation which states that it is obligatory to be able to track and trace products one step back and one step forward in the supply chain. There were no private voluntary standards like Fair Trade and UTZ certified cocoa at that time yet. The focus of the company was and still is to comply with this legislation and therefore the company has a compliance-oriented strategy. In this case, the existence of public obligatory standards led to a particular traceability strategy, which is conformable with the interaction shown in literature.

### *Interaction between standards and the traceability implementation elements ( 7 )*

A standard might also influence the implementation of the traceability system, because certain standards, like the Fresh Produce Traceability guidelines, provide guidelines for the implementation of traceability.

The laws and regulations describe minimum requirements for traceability. Based on these minimum requirements, the company designed and implemented its traceability system. According to Oxfam Novib, investments are needed comply with the requirements of a particular standard, so these requirements influence the implementation of the traceability system. These results are conformable with the interaction found in the literature.

### *Interaction between informal governance mechanism and traceability system ( 8 )*

In order to implement traceability, information needs to be shared in the supply chain. Therefore, relational governance in which information exchange norms are created could be beneficial for the realisation of traceability.

The company did not recognise relational governance, trust, commitment and reputation as important for traceability. The company tracks and traces one step back and one step forward in the chain, which is obligatory for each company. Because it is obligatory, the other parties in the chain have to share data with the company. Strong collaboration and relational governance is not important for the sharing of information in the company's opinion, which does not support the literature.

According to Oxfam Novib, informal relationships including trust might be beneficial for the realisation of a traceability system. When parties in a supply chain trust each other and they collaborate with each other, it might be that this trust and collaboration make the parties decide to realise a traceability system together. Thereby, Oxfam Novib is supporting the hypothesised interaction.

### *Interaction between traceability system and informal governance mechanism ( 9 )*

Implementing a voluntary traceability system might increase the asset specificity (Banterle and Stranieri, 2008). According to Anderson and Weitz (1992), this high asset specificity might lead to higher commitment and thereby influencing the informal governance mechanism.

The company did not implement a voluntary traceability system, because the traceability was implemented because it was obligatory. There have not been made big transaction-specific investments too, so this interaction was not visible within the company. According to Oxfam Novib, traceability effects the informal governance mechanism, namely traceability could be the basis for trust and a prolonged collaboration between parties in the supply chain. Furthermore, traceability could be beneficial for the reputation of a company, when the company is transparent about its traceability system.

### *Interaction between traceability strategy and traceability implementation elements(* 10 *)*

The traceability strategy and objective might also interact with the traceability implementation steps. When a market-oriented strategy is chosen, which means that the aim is to realize full traceability throughout the supply chain, the level of traceability might be high. This influences the identification of products, logistics units and locations, because there is a higher probability that the level of identification will be on product level instead of batch level in this case. The strategy will also influence the way in which the traceability data is captured and stored, how it can be retrieved, and the way in which the communication of the traceability data will take place. When a market-oriented strategy is chosen it is more likely that more advanced tools like RFID tags or biometrics are used to capture data. There is also a larger probability that more advanced technologies, like Electronic Data Interchange, will be used to store and communicate the data.

The interviewed company has a compliance-oriented strategy. Based on the interaction found in literature, the expectations are that the company did not invest in very advanced tools and systems to gather and store traceability data. These expectations were confirmed by the company, because there are no advanced tools to gather data (a part of the data is still gathered by hand) and also no separate systems to store the data. The data are stored within an already existing ERP system, to which one special traceability module was added.

A description of the traceability system of the interviewed company:
The company gathers lot codes of raw materials and packaging material. Furthermore, it gathers information about the day of production, the production shift that produced the products, which chocolate was used to produce the product, which supplier the chocolate has delivered, and to which distribution centre and customer the product was delivered. The product code contains a batch number, which is shared in the supply chain between the suppliers and the customers of the company.

A part of the data is gathered by hand. To the deliveries of the chocolate, pieces of paper are attached, which contain information about the product and the batch number. This information is transformed into an excel sheet. The product codes are entered into the central company system, which is an ERP system. All data are stored within the ERP system.

There is no active communication about the traceability data. Employees within the company have access to the ERP system in which the data can be retrieved when needed. The communication with other actors in the chain takes place via pieces of paper which are attached to deliveries.

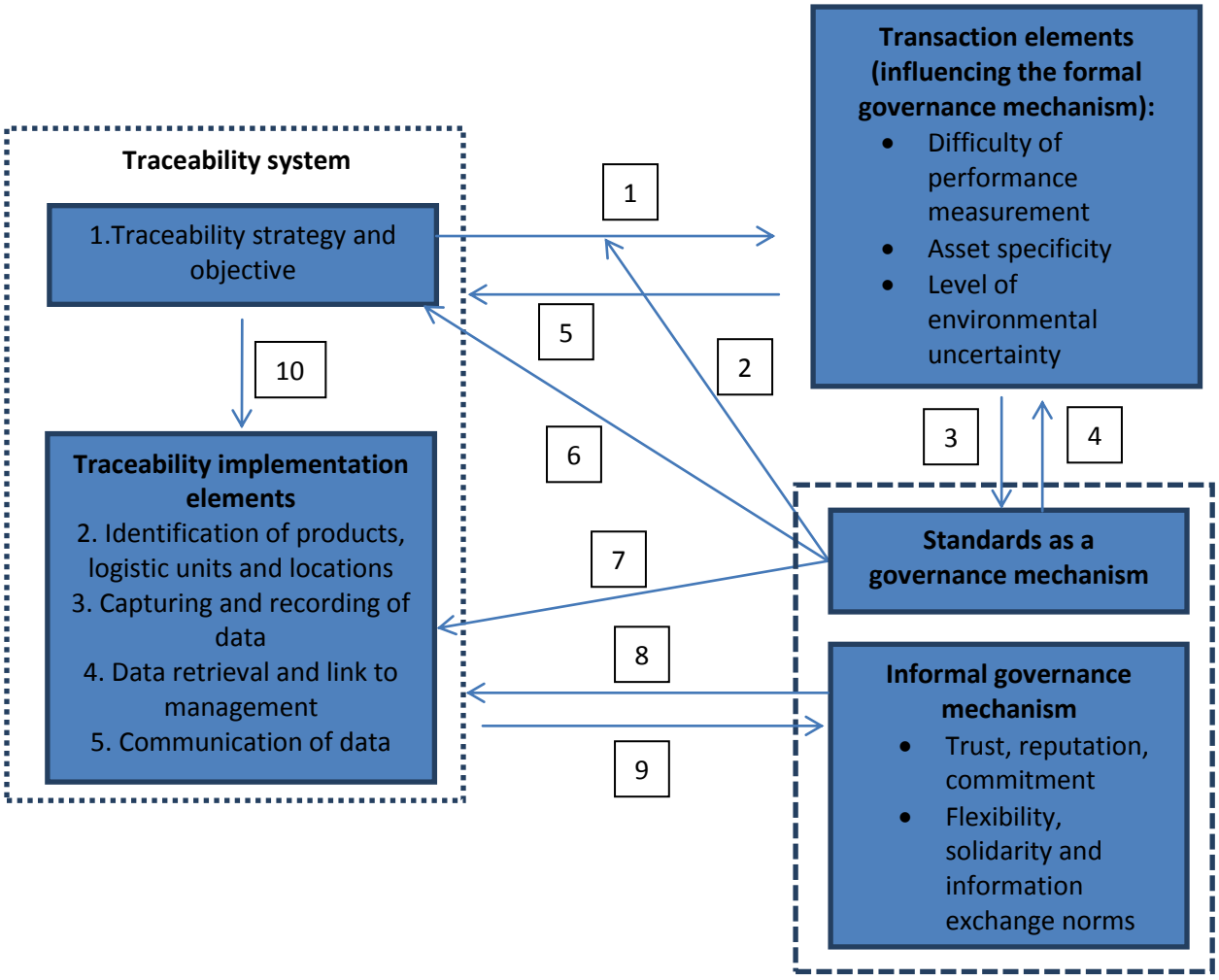


Figure 14: 'Interactions between traceability elements, transaction elements and governance mechanisms'

## 4.4 Conclusion

The sub question to be answered in this chapter was 'How is the cocoa - chocolate supply chain set up and what is the result of the application of the traceability interaction framework to this supply chain?'.

The cocoa-chocolate supply chain starts with the cocoa farmers, which are mainly located in West Africa, South East Asia and Latin America. The cocoa farmers sell their cocoa to local collectors or cooperatives, who collect all cocoa beans of local farmers and sell the cocoa to local traders, or the farmers sell their cocoa beans directly to local traders (Fowler,2009; Syahruddin, 2011). The local traders sell the cocoa to local processors, who deliver the cocoa in their turn to local manufacturers, who sell the cocoa to overseas processors. The local traders might also sell the cocoa to exporters, who sell the cocoa to overseas cocoa bean buyers. The overseas processors and cocoa bean buyers deliver to chocolate manufacturers, who produce chocolate out of the cocoa beans and other ingredients. The chocolate manufacturers sell the chocolate to merchandisers, who sell the chocolate products in their turn to retailers. The retailers deliver the chocolate products to consumers, who are the last actors of the supply chain (Syahruddin, 2011).

The result of the application of the traceability interaction framework to the cocoa-chocolate supply chain is that several hypothesised interactions were supported by the interviewed chocolate processing company and Oxfam Novib, but there were also some interactions which were not supported by the interviewed parties. The following interactions were supported by the interviewed

parties: the third interaction, the fourth interaction, the sixth interaction, the seventh interaction, the ninth interaction and the tenth interaction (see Figure 14). The following interactions were partly supported by the interviewed parties: the first interaction, the second interaction and the eighth interaction. The fifth interaction was not supported by the interviewed parties.

# Chapter 5 Conclusion

The research question to be answered in this study was 'How do traceability systems, governance mechanisms and transaction elements influencing these governance mechanisms of a food supply chain interact, in order to assure a food product's origin and used production methods?'. This question was answered by the answers on the four sub questions. Firstly, a short summary will be given of the traceability elements, the governance mechanisms and transaction elements, before the research question will be answered.

## 5.1 Traceability elements

According to Golan et al (2004), traceability is the ability to track a product's flow or attributes throughout the production process and supply chain. The answer on the first sub question was that there were five important elements to take into account when implementing traceability (Mgonja, 2007). These elements include a traceability strategy and objective, and four traceability implementation elements, namely the identification of products, logistic units and locations, the capturing and recording of traceability data, the data retrieval and link to management, and the communication about the data, which together form a traceability system. A short summary of the five elements will be given below:

- The identification of the traceability strategy and objective is the first important element to take into account when implementing traceability. According to Van der Vorst (2004), there are three main traceability strategies, namely a compliance-oriented strategy, a process improvement-oriented strategy, and a market-oriented strategy. The traceability objective reflects what the company wants to achieve with the traceability system.
- The second important element is the identification of the unique identity of products, logistic units and locations. The locations represent the different actors and the roles of the different actors in the chain. After that the relevant trade items or traceable resource units (TRU) and the logistic units, consisting of trade items, need to be defined. When the definitions of the trade items, logistic units and locations are given, they need to be uniquely identifiable, which could be done by the common used EAN-UCC identifiers.
- The third element involves making decisions about how to capture and record the traceability data. RFID, barcodes and biometrics are widely used technologies for this (Trienekens and Van der Vorst, 2006; Regattieri (2007)).
- The fourth element is about data retrieval and linking data to management. In this step, the technologies, used for the capturing of traceability data, need to be integrated in the administrative systems. Examples of common used systems are Enterprise Resource Planning systems, Warehouse Management Systems, and Laboratory Information Management Systems.
- The fifth element involves decision making about the communication of the traceability data in the supply chain, so that a continuous information flow in the chain can be realized. Common data systems used for this are e-mail, Electronic Data Interchange, and Extendable Markup Language.

## 5.2 Governance mechanisms and transaction elements interacting with traceability

After main traceability elements were identified, important governance mechanisms and transaction elements, influencing traceability, were studied. The governance mechanism is about how the coordination of a transaction is organised. In the third chapter of this study, the interaction between different governance mechanisms, transaction elements and traceability was studied. Formal governance mechanisms were derived from Transaction Cost Economics. A formal governance mechanism is about how two parties formally arranged the transactions between them by establishing formal rules in for example a contract. Transaction Cost Economics investigates the different possible governance mechanisms between two parties based on the type of transaction that they execute (Williamson, 1979; Wever et al, 2012). A transaction has three critical elements by

which it can be characterised, namely the difficulty of performance measurement, the amount of environmental uncertainty and the asset specificity. These transaction elements interact with a traceability system in various ways, which will be described below.

One of the main criticisms on Transaction Cost Economics is that the importance of informal relationships between people is not really included, while these informal relationships might also function as a governance mechanism. To compensate for this criticism, Social Network theory was used as an approach for these informal governance mechanisms. Within Social Network Theory, flexibility, solidarity and information exchange norms are very important for the creation of cooperation (Poppo and Zenger, 2002). Furthermore, trust, commitment and reputation are considered to be important for the informal relationships between two parties.

Next to the formal and informal governance mechanisms, standards might coordinate the transactions between two parties when there is a third party checking compliance with the requirements of the standard (Nadvi, 2008). Standards can be classified into three different categories based on whether they are private or public and voluntary or obligatory (Grote and Kirchhoff, 2001). Public obligatory standards are regulations and laws established by governments, which are thereby made obligatory for companies. An important law on traceability is included in Regulation 178/2002 (the General Food Law) states that companies should be able to track and trace their products one step backward and one step forward. Private obligatory standards are not made mandatory by governments, but by the companies in a sector. These standards function as access requirements to which the companies in the sector have to comply when they want to enter the markett (García Martinez and Poole, 2004). Private voluntary standards can be used by companies to differentiate themselves in the market.

## 5.3 Interactions between governance mechanisms, transaction elements and traceability systems

The research question to be answered was 'How do traceability systems, governance mechanisms and transaction elements influencing these governance mechanisms of a food supply chain interact, in order to assure a food product's origin and used production methods?'. The answer is that several interactions have been found between the five traceability elements, the governance mechanisms and the transaction elements in a food supply chain (see Figure 15). The validity of the interaction has been tested by an application of the framework to the cocoa-chocolate supply chain. Two interviews have been conducted with parties who are involved in the cocoa-chocolate supply chain, namely Oxfam Novib as a NGO and a chocolate processing company. The result of this case study in the cocoa-chocolate supply chain was a confirmation of several interactions, but also some rejections of interactions. The interactions as found in literature are described below and whether these interactions were confirmed by the interviewed parties of the cocoa-chocolate supply chain.

### *Interaction between traceability strategy and transaction elements (* 1 *+* 2 *)*

According to Van der Vorst (2004), there are three main traceability strategies, namely the compliance-oriented strategy, the process-improvement strategy and the market-oriented strategy. These strategies will have implications for the transaction characteristics. When a compliance-oriented strategy is chosen, which means that a traceability system is implemented because of public obligatory standards, there would not be an effect on the transaction characteristics (Banterle and Stranieri, 2008). However, when a market-oriented strategy is chosen and a traceability system is implemented on a voluntary basis, there might be an effect on the transaction characteristics. The effect might be an increase in asset specificity and a decrease in uncertainty throughout the supply chain (Banterle and Stranieri, 2008). So there might be an effect of the chosen traceability strategy on the transaction characteristics, but this effect is influenced by the type of standard in reaction to which the traceability system is implemented. This interaction was confirmed by the interviewed company, who has a compliance-oriented traceability strategy.

### *Interaction between standards and transaction elements ( 3 )*

In a particular standard, guidelines and requirements are identified. Private voluntary standards might have higher requirements for the products for which the company wants to use the standard. To comply with the standard, specific investments in for example human capital or specific machinery might be needed. So a standard might increase the asset specificity in order to meet the requirements of the standard. This interaction was confirmed by Oxfam Novib.

### *Interaction between transaction elements and standards ( 4 )*

When there is a high asset specificity, standards might safeguard these investments. The same holds true for the difficulty of performance measurement. When the difficulty of performance measurement is high, among others the standard might function as a safeguard. By using a particular standard, a third party might be auditing whether the company is indeed complying to the requirements of the standard and thereby the third party is safeguarding the transaction-specific investments and the actual performance. This interaction was confirmed by the interviewed company and Oxfam Novib when a standard indeed has a third party auditing this standard.

### *Interaction between transaction elements and traceability elements ( 5 )*

The transaction elements might initiate the implementation of the traceability system. According to Banterle and Stranieri (2008), the human asset specificity and the geographical asset specificity of a transaction as two types of transaction-specific investments might be important factors in determining whether a traceability system will be implemented with a trading partner (see Figure 6). When two parties already have invested in specific trainings and education, it is more likely that a traceability system will be implemented than in a situation in which these investments have not been made . Furthermore, the geographical closeness of certified suppliers might also positively influence the choice for a traceability system (Banterle and Stranieri, 2008). According to Buhr (2003), the difficulty of performance measurement and the level of environmental uncertainty might also influence the choice for an traceability system (see Figure 2). When the environmental uncertainty and/or the difficulty of performance measurement are high, a traceability system might be required. However, this interaction was not confirmed by the interviewed company. It might be that the chosen traceability strategy influences the interaction, but further research is needed here.

### *Interaction between standards and traceability strategy ( 6 )*

The existence of particular obligatory standards might influence the strategy of a traceability system. Due to EU legislation on traceability, which states that every company should be able to track and trace their products one step backward and forward, companies have to implement traceability. When a traceability system is implemented only in reaction to this legislation, the chosen traceability strategy will be a compliance-oriented strategy. This interaction was confirmed by the interviewed company.

### *Interaction between standards and the traceability implementation elements ( 7 )*

A standard might influence the implementation of the traceability system. Certain standards provide guidelines for the implementation of traceability. For example the Fresh Produce Traceability guidelines provide information on how the products need to be identified, namely by the use of EAN-UCC codes. This interaction confirmed by both Oxfam Novib and the interviewed company.

### *Interaction between informal governance mechanism and traceability system ( 8 )*

In order to implement traceability, information needs to be shared in the supply chain. Therefore, relational governance in which information exchange norms are created could be beneficial for the realisation of traceability. According to Oxfam Novib, informal relationships including trust might be beneficial for the realisation of a traceability system. When parties in a supply chain trust each other and they collaborate with each other, it might be that this trust and collaboration make the parties decide to realise a traceability system together. Thereby, Oxfam Novib is supporting the

hypothesised interaction. The results of the interviews with Oxfam Novib and the chocolate processing company are not consistent, so further research will be needed to study this interaction.

### *Interaction between traceability system and informal governance mechanism (9)*

Implementing a voluntary traceability system might increase the asset specificity (Banterle and Stranieri, 2008). According to Anderson and Weitz (1992), this high asset specificity might lead to higher commitment. This interaction was confirmed by Oxfam Novib. Furthermore, Oxfam Novib provided a new insight that traceability could be the basis for trust and a prolonged collaboration and that traceability could be beneficial for the reputation of a company, when the company is transparent about its traceability system.

### *Interaction between traceability strategy and traceability implementation elements(10)*

The traceability strategy and objective might also interact with the traceability implementation steps. When a market-oriented strategy is chosen, which means that the aim is to realize full traceability throughout the supply chain, the level of traceability might be high. This influences the identification of products, logistics units and locations, because there is a higher probability that the level of identification will be on product level instead of batch level in this case. The strategy will also influence the way in which the traceability data is captured and stored, how it can be retrieved, and the way in which the communication of the traceability data will take place. When a market-oriented strategy is chosen it is more likely that more advanced tools like RFID tags or biometrics are used to capture data. There is also a larger probability that more advanced technologies, like Electronic Data Interchange, will be used to store and communicate the data. This interaction was confirmed by the interviewed company.

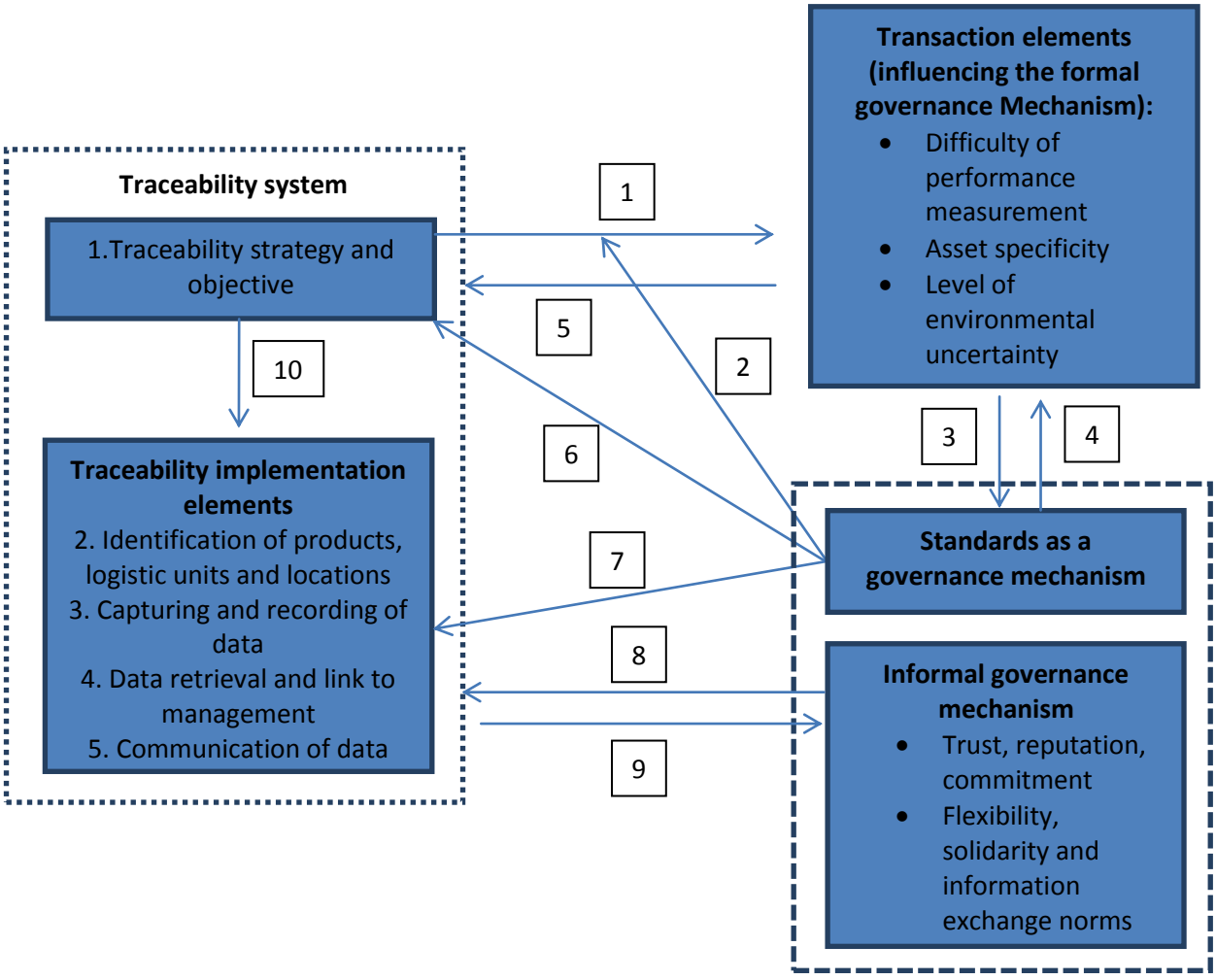


Figure 15: 'Interactions between traceability elements, transaction elements and governance mechanisms'

# Chapter 6 Discussion

In this chapter, the results of the application of the developed traceability interaction framework will be compared with the hypothesised interactions. For each interaction, it will be outlined whether the results of the interviews with Oxfam Novib and the chocolate processing company support the hypothesised interaction or not. Furthermore, the strengths and weaknesses of this study will be described. Next to that, the managerial implications of the study and suggestions for further research will be given.

## 6.1 Comparing the results of the application of the framework to the cocoa-chocolate supply chain with the hypothesised interactions

The hypothesised interactions are compared with the results of the case study in the cocoa-chocolate supply chain. The results of these comparisons will be described below and some possible explanations will be given when the results do not support the hypothesised interactions.

- The hypothesised interaction between the traceability strategy and the transaction elements is partly supported (interaction 1 and 2). The interviewed company had a compliance-oriented strategy, which did not result in any effect on the transaction elements. This is in line with the literature. A market-oriented strategy however might have an effect on the transaction elements, but this could not be tested for the cocoa-chocolate supply chain due to time constraints. Therefore, this part of the hypothesised interaction could not be supported.
- The third hypothesised interaction between standards and transaction elements is supported by Oxfam Novib. According to Oxfam Novib, investments are needed to comply with a particular standard and to maintain compliance. There are two types of investments, namely more technical and social investments. This is consistent with the hypothesised interaction. However, the results of the interviewed company were not in line with the literature, because the company did not made any investments. It might be that the investments to comply with the standard and to maintain compliance were made by the suppliers of the company. None of the suppliers was interviewed, so this is not known.
- The fourth hypothesised interaction between the transaction elements and the standards is supported by both Oxfam Novib and the interviewed company, in case that there is a third party responsible for auditing.
- The fifth hypothesised interaction between the transaction elements and the traceability system is not supported by the interviewed company. The company implemented traceability, because it was obligatory. The transaction elements were not relevant for the decision whether to implement traceability or not. It might be that the interaction between the transaction elements and the traceability system is dependent on the chosen traceability strategy. So when a compliance-oriented strategy is chosen, there might be no strong effect of the transaction elements on the traceability system and that when a voluntary traceability system is implemented with for example a market-oriented strategy, that there might be an effect of the transaction elements on the traceability system. More research will be needed to study this interaction.
- The sixth hypothesised interaction between standards and the traceability strategy was supported by the interviewed company. The existence of legislation made the company implement traceability and thereby it influenced the traceability strategy of the company, which is a compliance-oriented strategy.
- The seventh hypothesised interaction between standards and the traceability implementation elements is supported by both Oxfam Novib and the interviewed company. According to the interviewed company, the legislation on traceability describes minimum requirements based on which the company implemented traceability. Furthermore,

according to Oxfam Novib, private voluntary standards also describe requirements on traceability which influence the implementation of traceability.

- The eighth interaction between an informal governance mechanism and a traceability system was not supported by the interviewed company. The focus of the interviewed company is strongly on what is obligatory. However, Oxfam Novib recognises informal relationships including trust as important for the realisation of a traceability system. In this way, Oxfam Novib is supporting the hypothesised interaction. The results of the interviews with the chocolate processing company and Oxfam Novib are not consistent. It might be that the importance of an informal governance mechanism is dependent on the chosen traceability strategy, so that the informal governance might be more important when a market-oriented strategy is chosen than when there is a compliance-oriented strategy. Further research will be needed to study this interaction.
- The ninth interaction between a traceability system and informal governance mechanism is supported by Oxfam Novib. According to Oxfam Novib, a traceability system influences the informal governance mechanism. The interview with Oxfam Novib also provided a new insight about this interaction, namely that traceability could be the basis for trust and a prolonged collaboration. Furthermore, traceability could be beneficial for the reputation of a company, when the company is transparent about its traceability system.
- The tenth interaction between a traceability strategy and the traceability implementation elements is supported by the interviewed company. The interviewed company has a compliance-oriented strategy for which it would be expected that no big investments in advanced techniques and systems have been made to gather and store data. This was the case for the interviewed company, the only investment that was made in order to realise traceability was the addition of a module to the already existing ERP system.

## 6.2 Strengths and weaknesses

This study has several strengths, but also some weaknesses, which will be described below.

### *Strengths:*

- An important strength of this study is the developed framework. There was a gap in the scientific literature regarding the interactions between governance mechanisms to organise transaction is a supply chain, the elements influencing these governance mechanisms and traceability. According to Van der Vorst (2004), a lack of chain organisation might be a barrier to the implementation of traceability. This finding shows the importance of chain organisation for traceability. Therefore, the developed framework might be an important contribution to the literature.
- Next to the contribution to the scientific literature, the framework might contribute to the insights of the actors in food supply chains regarding traceability. Traceability is important for each company in a food supply chain in the EU, importing in the EU or exporting from the EU, because it is obligatory for these companies to track and trace their food products one step forward and backward. Therefore, traceability is a relevant topic for many companies, to which the developed framework can provide more insights.
- Another strength is regarding testing the validity of the interactions of the traceability framework. To check this validity, interviews have been conducted with actors from practice. This approach provided important insights as described in paragraph 6.1.

### *Weaknesses:*

- Due to time constraints, it was only possible to conduct two interviews with actors from the cocoa-chocolate supply chain. However, the two interviewed parties had a totally different perspective on the supply chain, so although only two interviews were conducted, still important different insights were gathered from these interviews. More interviews with parties with another different perspective would have provide even more insights.

## 6.3 Managerial implications

The results of this study might be applicable to practice as well. The framework may provide companies in food supply chains with insights about the interactions around traceability. When a company wants to implement a traceability system, the framework identifies which factors a company has to take into account. When a company already has a traceability system, the framework might be used to identify opportunities to extent and/or improve the traceability system.

## 6.4 Suggestions for further research

Finally, I have some suggestions for further research, which I will outline below.

- The fifth interaction between transaction elements and a traceability system and the eight interaction between an informal governance mechanism and a traceability system were not supported by the application to the cocoa-chocolate supply chain. It would be very interesting to study these interactions.
- In the literature, it was found that there are two different perspectives in Social Network theory on the type of social relationship and social structure that is more favourable for cooperative behaviour and superior performance (Lazzarini et al, 2001) and that it is still not clear which perspective is most beneficial for cooperation and superior performance (Bellamy and Basole, 2012). Studies supporting the first perspective emphasise the role of dense networks and strong social relationships, i.e. repeated, affective, relational transactions (Coleman, 1990; Nelson, 1989; Krackhardt, 1992). Dense networks are networks in which agents are extensively connected to each other. These dense networks and strong social relationships might lead to trust, the creation of social norms, and thereby the promotion of cooperation (Lazzarini, 2001). In the traceability interaction framework, it is stated in interaction eight and nine that trust and the creation of social norms might be beneficial for the realisation of a traceability system. This means that dense networks with strong social relationships might be beneficial for a traceability system.

  However, other studies supporting the second perspective focus on weak social relationships and sparse networks with non-redundant contacts to bridge structural holes (Burt, 1992; Granovetter, 1973), which may generate new information and diversity. This new information and diversity might trigger innovation and create opportunities (Lazzarini, 2001). Weak social relationships reflect spot-market transactions that occur only occasionally. Structural holes reflect different networks that are not connected to each other. When two agents of each network connect to each other, they form a non-redundant relationship and thereby they bridge the structural hole. These sparse networks with weak relationships might lead to cooperation. Cooperation is needed when a traceability system is realised, because the actors in the supply chain need to share data with each other. In this way, sparse networks with weak relationships might also be beneficial for the realisation of a traceability system. It would be very interesting to study which type of relationship and social structure might be the most beneficial for the realisation of a traceability system.
- Oxfam Novib and the chocolate processing company gave some suggestions during the interview for other factors which might influence traceability. Oxfam Novib named the role of Watch Dogs, which are critical NGO's, the organisation of the government, consumer awareness and cooperation between different standards as important factors influencing traceability. The chocolate processing company emphasised the role of customer requirements for traceability. It would be interesting to study the interaction of these factors with traceability systems.
- The framework was applied to the cocoa-chocolate supply chain in this study. Applying the developed framework to other food supply chains might provide new insights. The cocoa-chocolate supply chain is mainly located in Africa and Asia. A supply chain which is located in different parts of the world might provide other insights. Next of the location of the supply

chain, there are many more chain characteristics which might provide new insights, for example the number of actors in a supply chain.

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# Appendices

## Appendix 1 'Advantages and disadvantages of RFID and barcodes'

### *Advantages of RFID*

The usage of RFID offers some advantages. Firstly, by use of RFID technology data can be captured in an automated way, resulting in less labour costs (Kelepouris et al, 2007; Sahin et al, 2002). Secondly, implementing RFID would only require small changes in the existing business processes (Kelepouris et al, 2007). Thirdly, RFID tags do not have to be placed outside the package or in a certain position so that the scanner could read the information, as it is the case for bar codes (Fawcett et al, 2007). This results in very simple and rapid identification (Sahin et al, 2002). Fourthly, RFID tags are less prone to damage (Fawcett et al, 2007).

### *Disadvantages of RFID*

There are some disadvantages and limitations of the usage of RFID. Firstly, the implementation in practice turned out to be difficult due to costs, privacy and security concerns (Turban and Volonino, 2012). Secondly, when traceability is implemented on a very detailed level, i.e. tags on every product, the amount of information to be managed becomes very big. This will put a pressure on the system's efficiency (Jansen-Vullers, 2003). Thirdly, when the level of traceability desired increases, the costs of the system become quite high (Buhr, 2003). Fourthly, there are some challenges when implementing RFID in the supply chain. Wu et al (2006) identified technology challenges, standardisation challenges, patent challenges, costs challenges, infrastructure challenges, return on investment challenges, and barcode to RFID migration challenges. Regattieri et al (2007) also identified the costs, standardisation and technology challenge. It is not clear what the exact costs of RFID tags are, but it is known that the costs of tag might vary strongly, depending on the requirements of the tag. According to RFID Journal (2013), the tag costs vary nowadays between €0.07 and €25. When the costs of a tag are high, it might put a pressure on the price of the end-product. Regarding the standardisation and technology challenge, there is a lack of standardized RFID protocols and scanning problems exist under certain electromagnetic conditions.

### *Advantages of the usage of barcodes*

The use of barcodes has some advantages. Firstly, barcodes are a highly accurate way to identify products (Smith and Offodile, 2002). Secondly, the identification of products can take place at relatively high speed (Regattieri et al, 2007). Thirdly, with the usage of barcodes, the identification process becomes automated (Regattieri et al, 2007). Fourthly, the barcodes are relatively cheap (Regattieri, et al, 2007). Fifthly, whereas scanning problems exist under certain electromagnetic conditions for RFID, this problem is absent for barcodes (Rizzi and Zamboni, 1999).

### *Disadvantages of the usage of barcodes*

However, the usage of barcodes also has some disadvantages. Firstly, the amount of information that can be stored on a barcode is limited (Kelepouris, 2007). Secondly, a barcode requires a line-of sight to be able to scan it, which implies human intervention. This human intervention results in higher labour costs than in the case of RFID (Kelepouris, 2007) and it gives room for errors and inefficiency (Regattieri et al, 2007). Thirdly, a barcode is vulnerable for damage (Regattieri et al, 2007). Fourthly, there are about 225 different barcode symbologies with its own rules for characters, endocation, printing, decoding requirements, error checking and other features (Trienekens and Van der Vorst, 2006). A barcode symbology refers to the bars and spaces encoded according to established rules for each barcode language (Smith and Offodile, 2002). This high number of different symbologies makes it more difficult to implement traceability in the whole supply chain, because every actor has to use the same symbology and when some actors are already using another symbology, they have to change their process. In practice, it turns out that only few symbologies are used (Trienekens and Van der Vorst, 2006; Smith and Offodile, 2002), but still there is not just one standard symbology to

use. According to Regattieri et al (2007), due to their disadvantages, barcodes are less attractive to the food sector.

## Appendix 2 'Advantages, disadvantages and the future of ERP

### *Benefits of using an ERP system*

The usage of an ERP system will provide certain benefits for a company. Firstly, an ERP system has one core database, which is used for all business processes. This makes all required data available at the same time for the whole company. Furthermore, by the use of one database, data duplication and updating problems are reduced, which will result in a lower number of errors (Rizzi and Zamboni, 1999). Another advantage of the usage of an ERP system is that it facilitates greater managerial control, faster decision making and a reduction of costs (Holland and Light, 1999; Al-Mashari et al, 2003). Thirdly, according to the Computer Technology Research Corporation (1999), an ERP system can offer a company tangible and intangible benefits. Some important tangible benefits identified are inventory reduction, increased productivity, reduction in transportation and logistics costs, and improvement in in-time delivery performance. Some intangible benefits are increased visibility of corporate data, improved responsiveness to customers, tighter integration between systems, increased flexibility, global sharing of information, and improved visibility in the supply chain. These benefits are however dependent on the adopted approach for evaluation, selection and process management of ERP systems (Al-Mashari et al, 2003). A lot of research is done on the identification of critical success factors and the implementation of an ERP system (Al-Mashari et al, 2003; Rao, 2000, Nah et al, 2001; Somers and Nelson, 2001). The factors identified in these studies will not be discussed in this study, because the aim is to compare different systems (ERP, WMS and LIMS) and thereby try to determine which system will be the best to use in order to create traceability.

### *Disadvantages of using an ERP system*

Using an ERP system also has some disadvantages. Firstly, ERP is a flexible system, which means that it can be adjusted to a company's wishes. However, this flexibility also means that ERP systems are very complex. Often a long implementation phase is needed to implement the ERP system, which takes a lot of time and money (Rizzi and Zamboni, 1999). The time needed to implement the system is tried to be reduced by the introduction of certain modelling tools, which only need adjustments to the particular company instead of installing all parameters (Rizzi and Zamboni, 1999). Another disadvantage is that although the usage of an ERP system will offer many benefits, a study of 63 companies showed that it took eight months before these benefits appeared (Al-Mashari et al, 2003).

### *Future of ERP systems*

Fawcett et al (2007) identified ERP II as an opportunity to create connectivity between the different actors in a supply chain by offering the possibility to share information in the supply chain. With ERP II data are available across the supply chain to authorized participants, who can access these data via the Internet. ERP II goes beyond the boundaries of the company, whereas ERP's focus is only on the company (Fawcett et al, 2007). ERP II might offer opportunities for traceability, however, before ERP II could be realised, each actor should be able to manage its own ERP system in a proper way (Fawcett et al, 2007).

## Appendix 3 'Information about the ISO 9000 and 9000:2000 series'

The ISO 9000 series provide a framework for quality management and quality assurance. Within the ISO 9000 series, there are standards for internal and external quality assurance. Internal quality assurance focuses on improving efficiency and the quality of products and services within a company. External quality assurance focuses on assuring quality to customers.

The ISO 9000:2000 series provide standards for designing a Quality Management System. These standards are not specifically created for the agribusiness and food sector, but they can also be applied to other sectors. Furthermore, the standards are not only focused on safety, but also on quality assurance. The ISO 9000:2000 series contain three different documents, namely the ISO 9000:2000, ISO 9001:2000, and ISO 9004:2000. In the ISO 9000:2000 documents, guidance is given on quality principles and on common language in the field of quality. Guidance on the design of a Quality Management System is given in the ISO 9001:2000 documents. In the ISO 9004:2000 documents guidance is given on continuous improvement methods.

## Appendix 4 'Interview with a chocolate processing company in the cocoa-chocolate supply chain'

The interview was held with the Quality Assurance manager from a consumer chocolate processing company in the Netherlands and Belgium. The suppliers of the company deliver liquid chocolate to the company and the company itself processes the liquid chocolate into chocolate products.

1. Can you give a description of your supply chain? From which suppliers do you get your raw materials and to which customers do you supply your cacao, etc.?

   The company processes liquid chocolate into chocolate products of their own brand and for private labels. There are two main suppliers of this liquid chocolate, namely Cargill and Barrie Callebaut. The cocoa beans used for the liquid chocolate are sourced from West Africa and Latin America. The chocolate products are delivered to retailers in the Netherlands and Europe.

2. What are existing standards in your cocoa supply chain, to which the supply chain complies?
   Public obligatory standards: The company complies to the regulations on traceability (EU Regulation 178/2002 of the General Food Law: tracing one step back and one step forward). This is done by product-codes, from which it can be derived from which chocolate batch the product was made, by which supplier this chocolate was delivered and to which customer the product was delivered.

   Private voluntary standards: A part of the products of the company complies to Fair Trade, UTZ certified cocoa and Rainforest Alliance.

3. Do you have a traceability system in your company and do you share this traceability system with other actors in the supply chain? For how long does the company have a traceability system?

   The company has a traceability system for more than 20 years. The system is mainly focused on the company itself instead of the whole supply chain, so data is only shared between the supply chain actors to comply to laws and regulations, but there is no collaboration to create one traceability system throughout the whole chain.

4. Can you describe:
   - which traceability data you gather

   The company gathers lot codes of raw materials and packaging material. Furthermore, it gathers information about the day of production, the production shift that produced the products, which chocolate was used to produce the product, which supplier the chocolate has delivered, and to which distribution centre and customer the product was delivered. The product code contains a batch number, which is shared in the supply chain between the suppliers and the customers of the company.

   - how you gather it

   A part of the data is gathered by hand. To the deliveries of the chocolate, pieces of papers are attached, which contain information about the product and the batch number. This information is transformed into an Excel sheet.

   The product codes are entered into the central company system, which is an ERP system.

- what kind of system you use to store the data
The data are stored in an ERP system.

- and how you communicate about this data?
There is no active communication about the traceability data. Employees within the company have access to the ERP system in which the data can be retrieved when needed. The communication with other actors in the chain takes place via pieces of paper which are attached to deliveries.

5. In the scientific literature, people distinguish between three different traceability strategies. The first one is an compliance-oriented strategy, which means that traceability is implemented because it's obligatory. The second strategy is process-improvement, which means that a company strives for traceability within the own company to comply with rules and regulations, but also better return. The third strategy is the market-oriented strategy, which implies full traceability throughout the whole supply chain to create added value. Which of these three strategies approaches your traceability strategy, i.e. what you want to achieve with your traceability system?

   The company has a compliance-oriented strategy, because the main focus is on complying to laws and regulations. The products with the private voluntary standards are only a small part of the company's products.

6. Did your chosen traceability strategy influenced the choice of which techniques and systems you use to gather data, save it and communicate it with your supply chain partners? If yes, how?

   Yes, the goal of the company is to comply with laws and regulations. Therefore, the company did not made big investments in advanced systems to gather data and store data. The traceability system was fitted into the existing systems of the company.

7. Do you think that your traceability strategy is influenced by the standards to which you comply? If yes, in which way?

   Yes, by the legislation (private obligatory standards) that existed at the time when the traceability system was implemented. In reaction to these regulations and laws, the company implemented traceability. There were no private voluntary standards like Fair Trade and UTZ certified at that time yet.

8. Do you think that the implementation of the actual traceability system is influenced by the standards to which you comply? (i.e. which techniques you use to gather data, store data and to share this data with supply chain partners)

   Yes, the laws and regulations describe minimum requirements for traceability. According to these minimum requirements, the company developed the traceability system.

9. Did you make some investments to realise this traceability system? If yes, can you describe what kind of investments these are?

   The company did not make big investments to realise the traceability system. There was already an ERP system within the company and an IT specialist created a special traceability module within the ERP system. Last year, the company made some investments in ISCC

labels due to requirements of a major Dutch retailer. On these ISCC labels, information about the product and its origin can be stored.

In my model, I distinguish between behavioural and environmental uncertainty. Behavioural uncertainty is uncertainty about the performance and behaviour of the other partners in the supply chain. Environmental uncertainty is uncertainty about demand, supply and technological developments.

10. When you decided to comply to the standards that you just described, did you recognise a change in the extent to which you were able to measure the performance of your supply chain partners, i.e. the behavioural uncertainty? If yes, in which way?

    The company did not really recognise a change in the amount of behavioural uncertainty. Only a minor decrease in behavioural uncertainty about the products which comply to the UTZ and Fair Trade standards, due to a yearly audit.

11. After you complied to some standards, did you recognise a change in the amount of environmental uncertainty, i.e. uncertainty about demand, technological developments, etc.?

    No. Maybe dependent on the position in the chain?

12. (WHEN COMPLYING TO STANDARDS): Do you think that your investments and the performance of your supply chain partners is safeguarded by standards? If yes, how?

    Partly, only the UTZ products by the auditing which is executed by a third party.

13. (IF HAVING A TRACEABILITY SYSTEM): Do you think that trust, reputation, duration of the collaboration, commitment with your supply chain partners is important for your traceability system? If yes, in which way?

    Not really.

14. Which factors are important for the implementation of a traceability system in your opinion?

    According to the company, the requirements defined by the standards are very important for the design of the traceability system. When something changes in the requirements, the traceability system needs to be adopted. Furthermore, the customer requirements are very important for the design of the traceability system. The company invested for example in ISCC labels in reaction to new customer requirements.

## Appendix 5 'Interview with Oxfam Novib'

1. Are there next to UTZ certified, Fair Trade and Rainforest Alliance also other important standards in the cocoa-chocolate supply chain?

   Yes, Organic is an important standard in the cocoa supply chain. Oxfam Novib did a study in which different standards in the cocoa supply chain were compared.

2. Which parties in the chain are often responsible for the implementation of the traceability systems?

   The big companies in the cocoa supply chain often have their own internal control system. The standards in the supply chain are also responsible for traceability in the chain.

3. In which way do the cocoa farmers have to comply to the traceability systems/ how are the farmers involved in the traceability systems?
   - which traceability data the cocoa farmers gather,
   - how they gather it
   - what kind of system they use to store the data
   - and how they communicate about this data?

   The small cocoa farmers are often connected to cooperatives. These cooperatives gather data from farmers about the cocoa and store these data on paper or in computer systems. However, the gathering or the storage of the data at the cooperatives is often not very reliable.

   The farmers can also sell their cocoa beans to local traders and work together with them.

   The costs of a traceability system are often allocated on the cooperatives and the small farmers, who are unable to pay these costs.

4. Which investments are needed in the chain to realise traceability?

   Two types of investments are needed to realise traceability, namely technical investments and investments in human capital/ social investments. The technical investments involve computers, computer systems to store the data and housing. The social investments involve education, teaching farmers how to read and how to write, trainings in for example bookkeeping, how to use computers, and how to gather and store data. The big companies in the chain also invest in internal audit systems.

5. Do you recognise a change in the sale opportunities of the farmers after the implementation of traceability? (environmental uncertainty)

   Yes, the parties in the supply chain (often the big international traders, cocoa processors, chocolate producers or retailers) did make investments to realise the traceability system. To safeguard these investments, the parties which made the investments want to have prolonged trade relationships with the cooperatives and the farmers. This offers the farmers less uncertainty about whether they are able to sell their cocoa beans. However, a potential threat for the farmers is, when they are committed to a particular party and supply chain, that this party has the power to lower the price the farmers get for their cocoa beans.

6. How is the compliance with the traceability requirements in the supply chain checked?

The compliance with traceability requirements is checked by external certification. Third parties are responsible for yearly audits. These auditors are also monitored.

7. How are the requirements of a standard designed?

   There is feedback from third parties, like NGO's, on the established requirements of a standard. According to this feedback, the requirements could be adapted.

8. How is the compliance of the standards in the supply chain monitored?

   The compliance with standards is checked by external auditors. These audits are done yearly and during an audit, the auditors check the books and information which is stored in it and they visit the farmers. The audits are however not completely reliable, because things might be overlooked or not recognised.

9. Does the usage of standards by farmers lead to better sale opportunities, or in other words less uncertainty about sale opportunities?

   In theory, the usage of a standard will lead to better sale opportunities for farmers, because the certification with a standard will create value added. However, the farmers do not always have the contacts and a network to use this value added and sell the cocoa beans against a higher price. When there is a party to which the farmers can sell their cocoa beans, it does not immediately mean that the farmers get extra value for their cocoa. Often the farmers have higher costs due to the requirements of the standard and when the price of the cocoa is not that high, it could be that the profit of the farmers does not increase.

10. What kind of investments are needed to comply to particular standards and how do the actors in the supply chain maintain the chain relationships to safeguard these investments?

    More technical investments, like computers, computer systems and housing, and social investments, like trainings and education, are needed. There are investments needed in the beginning to comply to the requirements of the standard, which are often partly paid by the supply chain itself and partly by donations from for example governments. The costs of maintaining compliance to the standard (the costs of compliance) need to be paid completely by the supply chain itself. The farmers need to have extra income to be able to pay these costs of compliance.

    The big international cocoa traders, like Cargill and ADM often cooperate with farmer cooperatives. These international cocoa traders invest in cooperatives by providing trainings to them. In this way, they want to establish a long trading relationship. The farmers often do not have enough knowledge about the market to decide whether an offer from such an international trader is beneficial for them, also in the long term. There is much competition between traders to cooperate with farmers and cooperatives. Then the farmers are often not capable to determine which offer is best for them. Therefore, more investments in the cocoa supply chain are needed to provide the cocoa farmers this knowledge.

11. Do you think that trust, reputation and duration of the collaboration are important for a traceability system? If yes, in which way?

    Creating transparency about traceability could be beneficial for the reputation of a company. Trust and duration of a collaboration are often connected. When you trust the other party, there is a large probability that you will work together with that party for a longer period of

time. Traceability could be the basis for trust and a prolonged collaboration. The implementation of a traceability in a supply chain could create trust and collaboration between the parties.

It also works the other way around. When two parties trust each other and they collaborate with each other, it might be that this trust and collaboration make the parties implement a traceability system together.

12. Is there cooperation between farmers by the usage of standards and what does this cooperation involve? Are there prolonged relationships in the cocoa supply chain? If yes, between which actors?

    Yes, there is cooperation between the farmers in the form of cooperatives. The farmers have to cooperate, because separately they are too small. Via this cooperative, the farmers sell their cocoa.

    There are prolonged relationships in the cocoa supply chain. Large international cocoa traders and processors and chocolate producers are active in the cocoa producing countries. In these countries, they source a part of their cocoa from preferred suppliers (which are cooperatives), with whom they have a prolonged relationship. The remainder of the needed cocoa is bought from local traders. These relationships have a positive effect on the farmers, because they are less uncertain about whether they are able to sell their cocoa beans.

    There are also prolonged relationships between retailers and farmers and cooperatives, which do not always have a positive effect on the farmers. In these relationships, very specific investments are made by the retailer and the farmers. This makes it difficult for the farmers to switch to other customers, when the offer of the retailer is not that good anymore. The farmers got stuck in the relationship and the retailer has the power to lower the prices and worsen the conditions.

13. Which other factors are important for the implementation of traceability in your opinion?

    - The Watch Dogs play a very important role for traceability. Watch Dogs are critical non-governmental organisations, which have a critical attitude against the state of affairs in a country and the living and working conditions of the farmers.
    - A well organised government, which has established good norms regarding minimum wages, working conditions, etcetera.
    - Consumer awareness about traceability, so that consumers are aware where their products come from and that they value this information.
    - Cooperation between different standards, so that it becomes easier for farmers to switch between different standards.