RFID-integrated plastic pallets in the grocery industry
Contribution to supply chain efficiency

Master thesis in International Logistics and Supply Chain Management

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Master of Science Thesis within Business Administration

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Abstract

Problem – Companies and supply chains, such as those in the grocery industry, continuously face stricter requirements in the form of customer satisfaction, quality, profit margins, as well as information sharing in order to stay competitive. One specific technology that may be used in dealing with increasing competitive demands is the radio frequency identification (RFID) technology. A wide body of research recognizes the positive impacts from RFID, yet even so, doubts and uncertainty have been present among different supply chain members in industries striving to put the RFID technology to use. Nevertheless, many actors in the Norwegian grocery industry are replacing traditional wood pallets with plastic pallets, and these pallets are integrated with RFID tags.

Purpose – The purpose of this thesis is to investigate how plastic pallets with integrated RFID tags can contribute to improve supply chain efficiency in the grocery industry. Also, the managerial perception on the pallets and their accompanying technology will be compared to the existing literature, to identify if the managerial opinion supports the literature, and if not, where the gaps exist.

Method – The thesis combines an exploratory and an explanatory qualitative study of the managerial perception of RFID pallets in the Norwegian grocery industry, and investigates whether the perception supports the literature. The empirical material is gathered through telephone interviews with logistics and warehouse managers in the various companies.

Conclusions –

Physical implications: The managerial perceptions’ support towards the addressed implications of the reviewed literature is mixed. RFID pallets improve automatic operation processes through reduction in downtime and eases physical handling of pallets. Additionally, sorting of pallets becomes less labor demanding. Regarding holding of goods, the managerial perceptions do not seem to view RFID pallets as an important factor for efficiency improvement.

Information related/RFID aspects’ implications: The managerial perceptions in these concerns were based on plans and thoughts, since the technology had not been...
put to use. There is a difference in producers’ and wholesalers’ perception of whether efficiency in receiving of goods can be improved through utilizing RFID pallets. Concerning dispatching of shipments, the managerial perceptions support the literature in that information-related activities can be automated, and thus improve efficiency and reduce risk of human errors. In regards to information sharing, the managerial perception supports the literature, but highlights that the information’s nature determines whether sharing is considered.

Further research could include the retail store level to get a more complete supply chain picture, and also apply the research methods to a larger area in order to investigate the transferability to other industries and countries.
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List of abbreviations

BOL – Bill of Lading
EAN – European Article Numbering
EDI – Electronic Data Interchange
ERP – Enterprise Resource Planning
EUR pallets – Euro pallets
HSE – Health, Safety and Environment
IMS – Inventory Management System
NLP – Norsk Lastbærer Pool
PDA – Personal Digital Assistant
RFID – Radio Frequency Identification
WMS – Warehouse Management System
Introduction

The first chapter of this thesis gives the reader an introduction to the topic and a brief introduction to the relevance of information and RFID technology in supply chain management. Further, the chapter provides a discussion of the problem at hand, followed by the purpose of the thesis. Finally it ends with delimitations in accordance with the scope, as well as providing an outline of how the study is conducted.

1.1 Background

Companies and supply chains, such as those in the grocery industry, continuously face stricter requirements in the form of customer satisfaction, quality, and profit margins (Reitan, 2009) as well as information sharing in order to stay competitive. According to Dos Santos and Smith (2008) effective management of supply chains is one of the key areas for companies to gain a competitive advantage (cited in Zelbst, Green, Sower, & Baker, 2010). Wamba and Boeck (2008) state that the flow of information between supply chain members is recognized to be a strategic activity that enhances supply chain performance, and thus exchanging and sharing of information to improve supply chain performance is becoming critical to achieve competitive advantage. As a result, technological development is becoming increasingly important to meet these requirements and demands.

One specific technology that may be used in dealing with increasing competitive demands is the radio frequency identification (RFID) technology. Zelbst et al. (2010), propose that RFID technology utilization supports supply chain information sharing, which in turn improves the overall performance of the entire supply chain. Bose and Pal (2005) state that RFID technology can improve supply chain operations by using real time tracking to improve logistics management and specifically the overall warehouse operations, which leads to improved profitability. Visich, Li, Khumawala, and Reyes (2009) strengthen the view that RFID technology brings opportunities for several business improvements. Their study collects and shows empirical evidence of RFID benefits in operational and managerial processes in various supply chains. With a successful implementation of the technology, company executives are expecting that RFID will be able to improve efficiency, accuracy, visibility and security performance in the supply chain (Mehrjerdi, 2010).

Although a wide body of research recognizes the positive impacts from RFID, doubts and uncertainty have been present among different supply chain members in industries striving to put the RFID technology to use. For instance, different actors at different stages in the supply chain do not necessarily feel that they achieve the same benefits from the technology as the company that wants to implement the technology in the supply chain. In 2003, Wal-Mart mandated its suppliers (beginning with the top 100) to start RFID tagging of pallets and cases (Webster, 2008). In this occasion, a survey was conducted in December 2004 among companies involved in Wal-Mart’s project. Among the results, the survey showed that
42.3 percent of the respondents cited a lack of return on investment as concern number one. Also, the technology's high cost was a concern for 23.1 percent of the respondents (Cooke, 2005). Bottani and Rizzi (2008) also observe, through a feasibility study, that RFID implementation is not necessarily profitable for all members of the supply chain. Their study points out that the profitability for the different supply chain members depends on whether RFID implementation takes place at pallet-case- or item level in the transporting of goods.

1.2 Problem discussion

Efficient information flow is critically important for supply chain management, and technological developments such as RFID can assist in various aspects of supply chain performance, for example materials handling and pallet tracking (Bose & Pal, 2005). The Norwegian grocery industry is replacing the traditional wood pallets with more robust plastic pallets (Schieldrop, 2011). Among the drivers for plastic pallets in the grocery industry have been; working condition improvements (health, safety, and environment – HSE benefits); weight and appearance consistency through the pallets’ entire lifetime; and lower costs than wood pallets due to a 10 year lifespan, compared to one and a half years for EUR pallets (Haugdahl, 2010).

Norsk Lastbærer Pool (NLP) is the company that provides the plastic pallets that have been put to use in the Norwegian grocery industry. When developing the pallets, NLP had a long-term perspective and therefore integrated RFID tags in the pallets (T. Romanich, personal communication, 2012-02-03). Therefore, implementation of the pallets will also enable the use of RFID technology to improve control and efficiency of pallet movements. However, Norwegian grocery industry companies feel, for instance, that the RFID technology is too immature to be put to use on a large scale, and think the European article numbering (EAN) barcode system will continue to be the preferred system in business (Dietrichson, 2011). Advocates for the RFID-technology, such as NLP, perceive the grocery industry as ‘sitting on the fence’, being characterized by an attitude saying that there is no reason to put RFID technology to use as long as there are few actors using the technology to interact with (Dietrichson, 2011). Therefore, the questions remain: How can RFID integrated plastic pallets contribute to improve supply chain efficiency in the grocery industry, and do the managerial opinions support the literature’s view?

1.3 Purpose

The purpose of this thesis is to investigate how plastic pallets with integrated RFID tags can contribute to improve supply chain efficiency in the grocery industry. Also, the managerial perception on the pallets and their accompanying technology will be compared to the existing literature, to identify if the managerial opinion supports the literature, and if not, where the gaps exist.

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1 Norsk Lastbærer Pool, translates to ’Norwegian load carrier pool’
1.4 Delimitations

RFID technology can be utilized at different levels (pallet, case, and item). Based on the level the RFID technology is utilized, different benefits can be recognized. Further, there is a difference between active RFID tags – transmitting their own signals, and passive RFID tags – only transferring data when it registers signals from an RFID-antenna. This thesis is limited to dealing with passive RFID tags integrated in plastic pallets, and will not study the benefits of the RFID technology in general. In the following, these pallets will interchangeably be referred to as ‘RFID pallets’ and ‘plastic pallets’.

The thesis will further be delimited to the grocery industry in Norway, since this industry has recently put the plastic pallets to use and since RFID tagging at the pallet level is currently being implemented in the industry. Additionally, this thesis will not focus on cost measuring of RFID pallet implementation.

The focus of the empirical study will be on producer, and wholesaler companies. The retail store level will not be included, since the RFID pallet has not been put to use at this stage in the supply chain at this point in time. For further clarification it therefore has to be mentioned that one of the two wholesalers that are interviewed in this thesis (COOP) is owned and part of the grocery retail chain that it serves, and thus shares the name with the retailer chain. The other wholesaler (ASKO) is owned by NorgesGruppen and serves all the grocery retail stores owned by this mother company.

1.5 Research questions

The research questions for the thesis are as follows:

- How can RFID pallets contribute to improve supply chain efficiency in the grocery industry?
- Do the managerial perceptions support the literature regarding RFID pallets, and if not, where are the gaps?

1.6 Outline

The thesis consists of six chapters, starting with an introduction and the background for the problem discussion and the purpose of the study, as well as formulating the research questions.

Chapter two presents the literature that is reviewed in order to answer the first research question and provide a foundation for the empirical research.

The third chapter describes the methods applied for data gathering and argues for the method choices, and it also evaluates the reliability and validity of the research.
Chapter four presents the empirical findings that are used in the analysis of the thesis.

The fifth chapter gives the analysis of the empirical findings, and compares these to the literature to answer the second research question.

The final chapter – chapter six, gives the conclusion for the research questions and brings suggestions for further research.
2 Literature review

This chapter gives an insight of the reviewed literature of this thesis. First, basic aspects of supply chain management and efficiency is described. Further, the importance of information for supply chain management is addressed, followed by a brief description of RFID technology and levels of RFID tagging. Additionally, aspects of material handling are addressed, and implications of RFID pallets in this concern are presented. Finally, the chapter presents NLP and briefly explains how the pallet pool cycle in the Norwegian grocery industry works.

2.1 Supply chain management and efficiency

Before discussing the aspects of supply chain management (SCM), an explanation of what a supply chain is and consists of, may help to provide a clearer picture of SCM aspects. ‘A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request.’ (Chopra & Meindl, 2010, p. 20). Reid and Sanders (2010, p. 93) define a supply chain as ‘...the network of activities that delivers a finished product or service to the customer.’ A supply chain therefore includes manufacturers, suppliers, warehouses, transporters, retailers, and the final customer. All of the mentioned actors play a crucial role in their supply chains in order for the customer’s request to be fulfilled. Even so, this does not mean that all supply chains have identical characteristics. They do not always consist of constant numbers and types of actors. Rather, different supply chains are designed according to, and dependent on, the customer’s needs and the roles played and the stages involved in those specific supply chains (Chopra & Meindl, 2010).

As seen in Reid and Sanders’ (2010) definition above, the term supply chain is also referred to as a network. Further, it is also referred to as logistics network (Simchi-Levi, Kaminsky & Simchi-Levi, 2004) and supply network (Rice & Caniat, 2003; Skilton & Robinson, 2009), since actors interacting with each other in a supply chain also cooperates with other actors from other supply chains. These network terms give a broader, more complex picture of the supply chain than what is often perceived with the term supply chain. Nevertheless, this thesis will use the terms supply chain and supply chain management, based on the grounds that these are the traditional terms regarding the field.

With the fierce competition and increasing customer expectation in today’s global markets, strategic handling of the steps and activities in the supply chain becomes vitally important for firms in order to survive. Simchi-Levi et al. (2004, p.2) define SCM as:

‘...a set of approaches used to efficiently integrate suppliers, manufacturers, warehouses, and stores so that merchandise is produced and distributed in the right quantities, to the right locations, and at the right time in order to minimize systemwide costs while satisfying service-level requirements.’
Emphasis is put on that all the actors in a supply chain and all activities within SCM are of importance in order for the supply chain to achieve what its objective should be: Maximizing overall value through the supply chain by being efficient and cost-effective through minimizing systemwide costs (Simchi-Levi et al., 2004; Reid & Sanders, 2010). Educational course books on SCM often view SCM as a pipeline for the efficient and effective flow of products/services, information, and financials (Langley, Coyle, Gibson, Novack & Bardi, 2009; Chopra & Meindl, 2010), with these three flows covering all the activities and stages mentioned in the definition above. Through combining the different views of SCM, a broad understanding of the term is achieved so that it may be viewed both as a network of chains and as a single chain consisting of a given number of firms.

Efficiency can be described in various ways depending on in which context the term is used. Reid and Sanders (2010) describe efficiency as performing activities well and at the lowest possible cost. According to Karkkainen (2003), efficiency also includes saving time in handling operations; and this is important to stay competitive in the market. Chen (1997) stresses that suppliers and buyers need to establish a close working relationship to seek ways to achieve maximum supply chain efficiency.

2.2 Importance of information for SCM

The importance of information in SCM is undisputable. Without the right information concerning the processes taking place through the supply chain, managers are not able to assess situations appropriately and take action to respond to each case in the best manner. Yücesan (2007) points out that ‘information is said to be the glue that holds supply chains together.’ (In Jung, Chen, & Jeong, 2007, p. 127). According to Langley et al. (2009) information is the lifeline of business, driving effective decisions and actions. Wamba and Boeck (2008) add that a high level of information flow integration is considered a key determinant of a firm’s efficiency. Fawcett, Ellram and Ogden (2007) stress four reasons for the increasing importance of accurate and timely information for optimal SCM:

1. Information about order status, inventory availability, delivery schedules, shipment tracking, and invoices is needed in real time for managers to provide exceptional customer satisfaction.
2. When dealing with uncertainty, information substitutes for inventory and may help to take costs out of the supply chain.
3. Information increases flexibility with regard to when, where, and how resources are utilized to gain competitive advantages.
4. Web-based information sharing is changing relationships between buyers and sellers, and redefining supply chain relationships.

Thus, it appears that for a supply chain to benefit from information sharing, some kind of cooperation between the supply chain actors is necessary. Nevertheless, through a series of case study interviews, Fawcett and Magnan (2002) found that of a company’s processes to integrate supply chains, at best, 95 per cent still took place among the triad of the company plus one tier upstream and one tier downstream. Fawcett et al. (2007) acknowledge this and claim that most managers find
it hard to collaborate in a meaningful way, both internally and externally, in spite of the innately appealing idea of cooperation.

This thesis focuses on information in regards to what benefits of efficiency that may arise when the actors in the grocery industry utilize pallet-level RFID tagging. Although this level of utilization does not provide the same amounts of detailed data as RFID tagging at the case-, or item-level would, research studies still highlight the possibilities of improved information sharing between supply chain partners through implementation of RFID technology and the electronic product code (EPC) global network. For instance, Wamba and Boeck (2008) show that RFID technology and the EPCglobal network has the potential to effectively enhance information flows in a supply chain through automating information-based activities, such as validation of shipping orders, filling out bill of lading (BOL), entering data from BOL in the enterprise resource planning (ERP) system, and dispatching tasks in the warehouse management system (WMS). This will, together with synchronization of information and product flows, and by allowing end-to-end information visibility in the supply chain, reduce potential human errors, as well as document handling and processing costs. However, Wamba and Boeck (2008) stress that to achieve the mentioned benefits; the involved actors must have a 'network collaboration' strategy in adopting the RFID technology.

Bottani and Rizzi (2008) agree with the notion of actors needing a 'network collaboration', or 'integrated' approach to the adoption and implementation of RFID, EPC standards, and the EPCglobal network to achieve the technology's full benefits. Their study shows that with an integrated approach, the implementation allows for real-time data availability and sharing through the supply chain.

With the focus in SCM on efficiency and cost-effectiveness to minimize systemwide costs while at the same time working to maximize value, technological development and utilization are becoming increasingly important in order for companies to keep competitive. As pointed towards by Zelbst et al. (2010), RFID technology is considered as one such technology that helps to improve overall supply chain performance through supporting supply chain information sharing.

### 2.3 RFID technology

The following sub-chapter will address the technicalities of the RFID technology, and describe its place in automatic identification and industry use.

#### 2.3.1 Automatic identification

'Automatic identification' is a term describing the technology that helps machines to gather information about and identify items. Companies want to identify items, capture information and transfer it into a computer without having human labor to handle the operation. The aim of an automatic identification system is to increase

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2 'EPCglobal® is leading the development of industry-driven standards for the Electronic Product CodeTM (EPC) to support the use of Radio Frequency identification (RFID) in today's fast-moving, information rich, trading networks.' (GS1, n.d.).
efficiency, reduce data entry errors and free up staff to perform more value-added functions. Technologies such as barcodes, smart cards, voice recognizers, optical character recognizer, and RFID can all be identified and categorized under the term ‘automatic identification’ (RFID Journal, n.d.a).

2.3.2 Industry standard use

The most used automatic identification technology in the grocery industry today is the barcode system. A barcode is a label containing information for identifying product packages or pallets. Barcodes are used to maintain accurate information on pallet level or item level. The information can only be read by a special barcode scanner and can be transferred into an information system. The main drawbacks of barcodes are that the scanner must have line of sight to be able to read the label (National Barcode, n.d.). Additionally, since barcodes are exposed on the outside of the labeled unit, they are at risk of being damaged, and thus unable to scan (Adap-talift Hyster, 2012).

2.3.3 Terminology and technical aspects of RFID

A good explanation of the RFID technology is provided by Zhu, Mukhopadhyay, and Kurata (2012):

RFID technology consists of an RFID tag and an RFID reader linked to a computer system. The tag itself consists of a chip and an antenna, where the chip is the component that store and process information, while the antenna receives and transmits the information to a computer system. Usually, RFID tags are used to store information about an object or a shipment. The object or shipment is given a unique identifying number which is part of the information stored in the tag. An RFID reader reads the information in the tag when the tag passes the reader. The reader then transfers the information to a computer system, and together this allows for tracking of physical movement in real-time. The following section describes the technical aspects of the RFID technology.

Active RFID tags
Active tags normally have their own transmitter and a power source, like a battery, or it draws energy from the sun or other sources. The read range for active tags is normally between 20 to 100 meters (RFID Journal, n.d.b).

Passive RFID tags
Passive tags do not have any form of power source, and will only be active and transfer information when it receives radio wave signals from an RFID reader. Passive tags can have a read range up to ten meters (RFID Journal, n.d.b).

RFID reader
The RFID reader is used to communicate with the RFID tags. The reader is equipped with antennas, which emit radio waves and receive signals back from the tag. Further, the reader passes the information to a computer, so the data can be analyzed (RFID Journal, n.d.b).
Frequency

The communication between the reader and the tags is done by radio waves. To be able to communicate, the reader and tag must be tuned at the same frequency level. RFID systems can use many different frequency levels, but generally the most used levels are low-frequency (around 125 KHz), high-frequency (13.56 MHz) and ultra-high frequency (860-960 MHz). Radio waves behave different at different frequencies, so to be able to use different applications the same frequency has to be chosen (RFID Journal, n.d.c).

Standards

The international organization for standardizations (ISO) has made a technology standard that specifies the standards that are used for communication between the tag and the reader. For supply chain applications, the most important technology standard is the ISO 18000 standard family. This standard family covers frequency bands from low frequency, high frequency and ultra-high frequency (RFID Journal, n.d.d).

The ISO 18000 standard also specifies data structure requirements which are compatible with EPC. EPC is a unique number given to the tag by EPCglobal. Each company that licenses and subscribes to the ISO 18000 standard is given its own number range for its items, so that no EPC number will be duplicated worldwide. The ISO standard is important when different actors are supposed to collaborate in a supply chain, domestic or international. By following the standard, all actors will have the opportunity to use the technology and each company’s RFID technology is capable to read and understand the information that is captured in the tags. This way each actor will be sure that they can support and get benefits from the technology (Gaukler & Seifart, 2007).

Levels of RFID tagging

As briefly mentioned in chapter 2.2, RFID tagging for tracking of goods in the grocery industry can usually take place at three different levels, namely pallet-, case- and item-level. Each level is different in regards to what information it can provide when put to use (Leung, Cheng & Hennessy, 2007).

In pallet-level tagging, tags are normally placed in each of the pallet’s four corners, to ensure that tags can be read from any angle when a pallet passes by a reader. Pallet-level tagging allows reading of an identification (ID) number on the pallet’s RFID tag, and registering of a shipment’s ID number into the RFID tag. This process enables a link between the pallet and the order number, as well as to the goods loaded on that specific pallet (Swedberg, 2010).

In case-level tagging, tags are often placed in both sides of the case. Case-level tagging is similar to the pallet level, and can capture information on the content that is placed in the case. At this level both active and passive tags are taken into use, the purpose will decide which type of tags is used. The primary advantage of case levels tagging is that it allows more detailed tracking than the pallet level, and smaller part of inventory is stored in the case (Leung et al., 2007).

Item-level tags are either attached to the item, or a part of the item package. Often at this level, active tags are used. Item-level tagging gives the highest possible visi-
bility in the supply chain, because it allows gathering real-time information at any
time (Leung et al., 2007).

2.4 Material handling

Together with the importance of information flow, efficiency in the handling and
flow of materials is also critical. Material handling can be defined as ‘short distance
movement of goods or materials within a storage area, involving loading, unloading,
palletizing, and depalletizing...’ (BusinessDictionary, n.d.). Arnold, Chapman and
Clive (2012) add that it takes place in or around a facility and also that it concerns
unloading and loading of transport vehicles.

Material handling activities take place both in inbound and outbound logistics sys-
tems. According to Fawcett et al. (2007) and Langley et al. (2009), the inbound sys-
tem of logistics can be connected to material management and the outbound logis-
tics to the term physical distribution. Further, integration between the inbound
and outbound system is important for the efficient and effective management of
the logistics supply chain (Langley et al., 2009). In the following, this thesis will
deal with inbound logistics as concerning the activities from receiving of goods in-
to a facility and to their point of storing. Outbound logistics will deal with activities
from the point of picking to also include transportation. Further, all activities per-
formed in or around a facility will be characterized as material handling activities,
regardless of whether those activities belong to inbound or outbound logistics.

2.4.1 RFID pallets

The RFID pallets that have been put to use in the Norwegian grocery industry are
produced by Shuert Technologies in collaboration with NLP (NLP, n.d.a). The Eu-
ropean standards for load carriers for transport of goods include a standard size of
1200mm*800mm (Arjo Produkter AS, n.d.), and the RFID pallets follow this stan-
dard (NLP, n.d.a). In comparison to traditional EUR pallets, the plastic pallets have
three main characteristics. First, the plastic pallet has a stable weight of 14.9 kilos,
making it eight to ten kilos lighter than a standard EUR pallet, depending on the
material used in the EUR pallet (NLP, n.d.b). Secondly, static loading capacity of the
plastic pallet is five tons (NLP, 2009), while for EUR pallets, the static loading ca-
pacity is four tons (Arjo Produkter AS, n.d.). Finally, the plastic pallets are integrat-
ed with four RFID tags that contain a unique pallet identification number, and al-
low writing and storing of information (NLP, n.d.c).

2.4.2 Material handling activities

To handle the movement of goods at and between the different actors in the supply
chain efficiently, a set of standardized activities become necessary. Arnold et al.
(2012) highlight eight activities as important to operate a warehouse. Even though
they name the activities as warehouse activities, in this thesis the activities are
viewed as necessary in all facilities, regardless of whether those are producer,
wholesaler, or retailer facilities.
The following activities are:

1. *Receive goods*- the company receive goods from outside transportation and accepts the responsibility for them. Control activities like checking goods against an order, checking the quantities, control the item’s condition are performed at this stage.

2. *Identify the goods*- the different items are identified and the quantity is recorded.

3. *Dispatch goods to storage*- goods are sorted and moved into storage.

4. *Hold goods*- The goods are kept in storage.

5. *Pick goods*- The item required is picked from storage and brought to the packaging area.

6. *Marshal the shipment*- goods that are making a single order are collected and checked for errors.

7. *Dispatch the shipment*- the order is packaged, shipping documents are created, and the goods are loaded on the right vehicle.

8. *Operate an information system*- a record must be maintained for each item in stock showing the quantity on hand, quantity received, quantity issued, and location in the warehouse.

It is important to mention that these activities can differ between the actors in the supply chain, but that in general they can take place in any facility. The following section will deal with the RFID pallets’ potential implication for these activities. Since the implementation of RFID at the pallet level, and the pallet itself, only affects certain activities, only these will be addressed.

### 2.4.3 Implications of RFID pallets for material handling activities

*Receive goods*
When RFID pallets arrive at a facility and go through the RFID reader portals at the receiving dock gate, the portals can automatically receive signals from the tags in the pallets and transmit the information the tags carry, to the company’s back-end information system (Jiang-Lang & Huang, 2006).

*Hold goods*
According to NLP (2009), the RFID pallets have a loading capacity of five tons in static storing, compared to four tons for EUR pallets. This additional one ton loading capacity per pallet enables storing of more goods in a given square meter area, thus leading to more efficient space utilization in a warehouse or storing facility.

*Dispatch the shipment*
When preparing goods for shipment, the use of RFID pallets enables the shipper to use handheld RFID readers to encode shipping order number and load destination on each pallet’s tag. Compared to a manual system where a packing list has to be
printed and attached to the shipping unit, an RFID solution reduces the time needed to dispatch the shipment. Additionally, when RFID pallets are loaded onto a transportation vehicle, they pass an RFID reader portal which controls that the pallets are loaded onto the correct vehicle (Swedberg, 2011).

In addition to Arnold et al.’s (2012) warehouse activities, the RFID pallets lead to implications for automatic operation systems and physical handling within a company’s facility, as well as for information sharing related aspects between the supply chain actors.

*Automatic operation systems*
For actors in the supply chain that use some kind of automatic operation system for pallet movement in their facility, the plastic pallet can improve the equipment uptime compared to EUR pallets. EUR pallets can have splinters and nails coming loose, which again can lead to downtime in these systems. Since the RFID pallets, are molded, they do not lead to such disadvantages (Sara, 2009).

*Physical handling*
RFID pallets will be easier to handle in activities that require physical handling. The lighter weight makes them more ergonomic and easier to handle for the workers (Sara, 2009).

*Implications for information sharing*
When RFID pallets pass by an RFID-reader portal at the shipping/receiving dock at a company’s facility, the information on the pallets’ tags is immediately read by the RFID portal and automatically forwarded to the back-end computer system. Additionally, the information is made available for other supply chain participants through a software solution that stores RFID data captured from RFID readers (Swedberg, 2011).

2.5 Norsk Lastbærer Pool

NLP is the company that manages the nationwide pool of the RFID pallets used in the Norwegian grocery industry, which this thesis focuses on. Therefore it is useful to give a presentation of the company and give an explanation of how the RFID pallet pool cycle in the grocery industry works.

NLP was jointly established in 2006 by the producer side (Dagligvareleverandørenes Forening3) and the retailer side (Dagligvarehandelens Miljø Forum AS4) in the grocery industry (NLP, n.d.d). The company manages the nationwide pool of pallets for transportation in the Norwegian grocery industry, and their mission statement is;

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3 Dagligvareleverandørenes forening, translates to ‘The grocery suppliers’ association’

4 Dagligvarehandelens Miljø Forum AS, translates to ‘The grocery retail trade's environmental forum’
‘In an as rational way as possible and with the lowest possible environmental footprint, develop and manage return systems for reusable cargo carriers for the Norwegian grocery industry’ (Tangen, n.d).

NLP started with introducing return systems for standardized wood Euro-pallets (EUR pallets) October 1st, 2007 (NLP, n.d.d). The EUR pallet is the standardized load carrier for transport of goods in Europe. In January 2010, NLP introduced its own standardized plastic pallet with the same features regarding size and loading limits as the EUR pallet to a selection of pilot project customers (NLP, n.d.e). After the pilot project testing of the pallet, it was introduced in full scale for the entire Norwegian grocery industry (NLP, 2011). In the end of 2011, the market share of the plastic pallets was 25 percent, but, in a long term NLP anticipates that the plastic pallets’ market share will stabilize around 65-70 percent. The reason for it to not reach 100 percent is the import of regular EUR pallets, which is expected to hold around 30 percent of the market (T. Romanich, personal communication, 2012-02-03).

2.5.1 Pallet pool cycle

In 2011, NLP started planning a pilot project in collaboration with the snack-food producer Maarud, the sausage producer Finsbråten, and two distribution centers of the grocery retail chain COOP. The pilot aimed to track the RFID pallets when they were packed and shipped from producers and when they were received at distribution centers (T. Romanich, personal communication, 2012-02-03). In the following, an explanation is given of how this pilot, and thus the RFID tracking and registering of pallets in the pallet pool cycle would work in practice (Information provided by T. Romanich, personal communication, 2012-02-03).
As seen in Figure 2.1, NLP’s pallet pool cycle can be viewed as a triangle that connects NLP, the producers, and the wholesalers (with retail stores as a sub-level to be included in the future). When NLP ships new pallets to the producers, the pallets are unloaded from the trailer with a forklift and driven through an RFID-reader portal at the producers’ loading dock. The RFID reader portal registers the entire volume of pallets that passes the portal, and passes the pallets’ identification number onto the company’s back-end computer system, which is connected to an NLP registering system via the Internet.

When the producers load the RFID pallets with products onto transportation vehicles, the pallets pass the RFID portals and are registered in the back-end computer system in a similar process as explained above. Thereafter, the loaded pallets are received at the wholesalers’ distribution centers, where once again the registration process takes place in the same manner as already explained.

In the pilot project phase, the last stage of RFID registering of the RFID pallets is at the wholesalers’ facilities, before the pallets are returned to NLP’s stations for any maintenance and cleaning work that might be necessary. However, the plan and goal for the project is to include the retail store level in the systems so that the pallets can be tracked and registered through the whole supply chain before they are sent back to NLP. An additional goal is to enable storing of information concerning the RFID pallet’s content, so that this can be shared among the supply chain actors (T. Romanich, personal communication, 2012-02-03).

Figure 2.1 NLP’s pallet pool cycle. (NLP, 2010)
2.5.2 Economical aspects

NLP has been managing the pallet pool cycle for the Norwegian grocery industry since its startup in 2007, and the company's experiences so far indicate that most of the actors in the industry are experiencing shrinkage of pallets at rates from one to five percent when registering pallets manually. In comparison, with the RFID technology systems, the registering of the RFID pallets will go automatically, and shrinkage is avoided (NLP, 2011).

*Table 2.1 Net annual savings from implementation of RFID solution (NLP, 2011)*

<table>
<thead>
<tr>
<th>Example small facility with 2 PDA's</th>
<th>Net annual savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACILITY SIZE</td>
<td>1% shrinkage</td>
</tr>
<tr>
<td>pallets delivered</td>
<td>2% shrinkage</td>
</tr>
<tr>
<td>10000 NOK 15 016</td>
<td>2% shrinkage</td>
</tr>
<tr>
<td></td>
<td>5% shrinkage</td>
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<tr>
<td>25000 NOK 75 016</td>
<td>5% shrinkage</td>
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<tr>
<td>50000 NOK 175 016</td>
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</tbody>
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<table>
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<tr>
<th>Example facility with 1 portal</th>
<th>Net annual savings</th>
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</thead>
<tbody>
<tr>
<td>FACILITY SIZE</td>
<td>1% shrinkage</td>
</tr>
<tr>
<td>pallets delivered</td>
<td>2% shrinkage</td>
</tr>
<tr>
<td>25 000 NOK 24 364</td>
<td>5% shrinkage</td>
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<tr>
<td></td>
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<tr>
<td>50 000 NOK 124 364</td>
<td></td>
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<tr>
<td>100 000 NOK 324 364</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Example facility with 8 portals</th>
<th>Net annual savings</th>
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</thead>
<tbody>
<tr>
<td>FACILITY SIZE</td>
<td>1% shrinkage</td>
</tr>
<tr>
<td>pallets delivered</td>
<td>2% shrinkage</td>
</tr>
<tr>
<td>200 000 NOK 369 260</td>
<td>5% shrinkage</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td>300 000 NOK 769 260</td>
<td></td>
</tr>
<tr>
<td>500 000 NOK 1 569 260</td>
<td></td>
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</tbody>
</table>

Table 2.1 is developed by NLP and shows the net annual savings in NOK that NLP states that different size companies can achieve by implementing the RFID solution. The top part of the table (green) shows cost savings for a small facility using two personal digital assistant (PDA) RFID scanners. The middle (red) table shows the equivalent numbers for a facility with one RFID portal, and the bottom table (yellow) shows numbers for a large facility with eight portals. For instance, the middle table (red) shows that a facility that experiences a shrinkage rate of five percent, and that gets 100 000 pallets delivered annually can potentially save NOK 1 124 364 by implementing the RFID solution.

2.6 Summary

This chapter has briefly introduced the reader to the concepts of SCM and efficiency, and the importance of material handling and information in SCM has been described. Further, an explanation of RFID technology and a description of the technology standard that the grocery industry mainly uses today have been given. Ad-
ditionally, implications of the RFID pallets for material handling and information related aspects have been treated. Finally, NLP and the pallet pool cycle for the Norwegian grocery industry have been presented.
3  Methodology

This chapter describes how the study will be performed and the methods applied for data gathering. Additionally, the chapter argues for the method choices, as well as evaluating the reliability and validity of the research.

3.1  Research approach

Ghauri and Grønhaug (2005) distinguish between two different research approaches, namely deduction and induction. The deductive approach can be explained as drawing conclusions through logical reasoning and it is associated with quantitative studies. The inductive approach is explained by Ghauri and Grønhaug (2005) as drawing conclusions from empirical observations, and this type of research is more often associated with qualitative studies.

This thesis makes empirical observations, through interviews, of managerial perceptions regarding RFID pallets’ potential contribution to improve efficiency in the grocery industry. Further, the study compares these findings with the reviewed literature on the subject to see whether the managerial perception supports the literature, or if it brings any gaps. Thus, the thesis mainly has an inductive approach, with elements of deduction in the comparing of the empirical findings with the literature. However, since the area of focus is the Norwegian grocery industry, a relatively small market in global scales, the comparison of managerial perceptions and literature is not necessarily significant for large-scale generalization. Rather, with their inductive nature, the findings give indications of areas to be studied for generalization in future deductive studies.

3.2  Research classification

According to Saunders, Lewis and Thornhill (2009), research studies can be classified as exploratory, descriptive, and explanatory.

Exploratory studies are appropriate when investigating underresearched areas, and their findings help shape directions for future research (Hesse-Biber & Leavy, 2011). Brannick (1997) characterizes exploratory research as dealing with research questions of ‘what’.

Descriptive studies are characterized by structured and well understood problems (Ghauri & Grønhaug, 2005), and Brannick (1997) characterizes this classification as dealing with questions of “when”, “where” and who”.

An explanatory study seeks an explanation of relationships between different components of a topic (Hesse-Biber & Leavy, 2011), and answers questions of “how” and “why” (Brannick, 1997).

The main focus of this thesis is towards the exploratory approach; since it deals with what the managerial perception is on RFID pallets in the Norwegian grocery industry. The findings from the study will contribute in the shaping of directions
for future research. Thus, the explanatory approach is also to a certain degree applicable for this thesis, as the literature review addresses how RFID pallets can contribute to improve supply chain efficiency. Even so, the core contribution of this study is focused on the exploration of the managerial perception of RFID pallets.

### 3.3 Research strategy

There are several different strategies of research; experiment, survey, case study, action research, grounded theory, ethnography, and archival research (Saunders et al., 2009). The research purpose determines which strategy is the most appropriate one, but a combination of strategies can also be used to strengthen the research.

A case study provides the possibility to explore a current phenomenon in a real-life context (Yin, 1994). In order to explore the RFID pallets’ potential in the Norwegian grocery industry and the managerial perception on the pallets, a case study strategy is chosen for this thesis. Case studies often concern the use of qualitative data, and data collection techniques include interviews, observations, and analysis of documents (Patton, 2002). Interviews with producers and wholesalers that have put the pallets to use are conducted in order to investigate the managerial perception of the RFID pallets. An introduction meeting with NLP, the company providing the pallets for the market, has also taken place to get an insight of the situation.

### 3.4 Quantitative and qualitative methods

To obtain information to solve a research problem, there is a distinction between quantitative and qualitative methods. In quantitative methods measurement is employed, while in qualitative methods it is not (Ghauri & Grønhaug, 2005). Quantitative methods also involve collection of numerical data and mathematically based analysis of these (Aliaga & Gunderson, 2002). Qualitative methods on the other hand, analyses data gathered through interviews or observation (Kumar, 2005), and aims to answer questions of ‘how’, ‘why’, and/or ‘what’ (Hesse-Biber & Leavy, 2011).

This thesis applies the qualitative method, since the study investigates questions of ‘how’ and ‘what’. Also, since the thesis is mainly characterized as an inductive and exploratory research, Ghauri and Grønhaug (2005) suggest that qualitative methods are the most appropriate. This thesis seeks to investigate the experiences and perceptions of producers and wholesalers in the Norwegian grocery industry, concerning RFID pallets, and not to measure specific situations in a quantitative way. Thus, the most appropriate method of choice is the qualitative case study approach.

### 3.5 Time horizon

Saunders et al. (2009) distinguish between longitudinal and cross-sectional time horizons. Longitudinal studies allow for investigation of changes or development in a context over time, whereas a cross-sectional research focuses on a specific
phenomenon at a single moment in time (Ruane, 2005). This thesis applies a cross-
sectional time horizon, due to the time restrictions of the study. Also, since the the-
thesis aims to capture the current managerial perception of the RFID pallets, a longi-
tudinal approach becomes inappropriate.

3.6 Data collection

Data collection for a research study is distinguished as primary and secondary data
(Ghauri & Grønhaug, 2005).

McDaniel and Gates (1998) describe secondary data as previously gathered data
which only might be relevant to the problem at hand. Secondary data include
books, journal articles, online data, sources such as webpages of companies, and
catalogues (Ghauri & Grønhaug, 2005). Primary data is described as new data
gathered to solve the particular problem at hand (McDaniel & Gates, 1998). Nor-
mally, this includes observations, experiments, surveys (questionnaires), and in-
terviews (Ghauri & Grønhaug, 2005).

The searches for secondary data for this thesis have been conducted through acade-
mic journal articles, educational course books, non-academic technical reviews,
company webpages, and newspaper articles. Gathering and reviewing secondary
data provides valuable insight to other researchers’ work on the field in focus, and
further contributes to the building of a theoretical foundation and understanding
for the thesis.

The primary data used for this thesis is gathered through interviews with actors in
the Norwegian grocery industry that have put NLP’s RFID pallets to use. The de-
scription and rationale for the chosen approach will be given in the following sec-
tion.

Semi structured interviews

Interviews as a data collection method can be classified as structured, semi-
structured, or unstructured. Tenenbaum & Driscoll (2005) describe the unstruc-
tured interview as having no predetermined questions, but rather taking the form
of a conversation between the researcher and the interviewee. The semi-
structured interview consists of a set of questions or issues to be explored with
each of the interviewees. Finally, the structured interview is described as an inter-
view where the researcher asks the same questions in the same way in the same
order to all the interviewees (Tenenbaum & Driscoll, 2005).

The interviews conducted for this thesis, have been developed structurally, but
conducted in a semi-structured manner. An interview guide with a set of questions
covering the topics to be explored has been developed for the thesis. This inter-
view guide consists of open-ended questions, indicating that it is structured. How-
ever, the interview guide will only serve as a checklist to make sure that the topics
of interest and relevance to the study are naturally brought up, or specifically
raised by the researchers in each interview (Tenenbaum & Driscoll, 2005). This
aspect is more in line with a semi-structured interview, since all the planned ques-
tions can be raised by the researchers, while it at the same time allows the inter-
viewee to answer freely (Morse & Field, 1995). It also allows for the researchers to
follow up topics that may arise from the answers. This latter point is of importance for this thesis, as the purpose is to investigate what the managerial perception on RFID pallets is and to see if this perception supports the reviewed literature, and/or if any gaps can be identified. A final rationale for choosing a semi-structured interview is that the interviewed companies for this thesis have different roles in their supply chain, and the interviewees have different positions within their companies. Therefore, an interview conducted in a semi-structured way enables the interviewees to answer individually and freely, based on their positions.

The topics that have been covered through the interviews are experiences and perceptions concerning physical aspects of the RFID pallets, perceptions concerning RFID/Information related aspects of the pallets, and general perceptions towards sharing of information with supply chain partners. The information from each actor has been gathered through telephone interviews, and where questions arose after the interviews, these questions were followed up via e-mail. All the interviewees received the interview guide on e-mail prior to the interview, in order to be prepared.

Five producers were interviewed for the thesis, namely Maarud, KiMs, Mills, TINE, and Rieber & Son (R&S). The two wholesalers COOP and ASKO were also interviewed. All of the companies were chosen because they had put the RFID pallets to use in their operations, and because they all are major actors in the Norwegian grocery industry, making their experiences and perceptions noteworthy as a representative selection of the industry’s overall perception on the topic. Although only two wholesalers have been interviewed, they have a major influence in the Norwegian grocery industry, since they are the two largest of a group of four major wholesalers in the country. Their combined market share in 2010 was 64 per cent, where ASKO had 40 percent⁵ and COOP 24 percent (Oslo Handelsstands Forening, 2010).

The interviewees from each company are responsible for the operations concerning the RFID pallets in their respective companies. All interviews were conducted through telephone. One company (COOP) had three interviewees, while all other interviews were conducted one-on-one. For further details concerning interviews, see appendix 2.

### 3.7 Reliability and Validity

In order for the thesis to be credible and in a state of objectivity, the reliability and validity of the research is critical (Kirk & Miller, 1986).

**Reliability**

O’Leary (2010) describes reliability as concerning internal consistency – i.e. if data/results collected, measured, or generated are the same under repeated trials. She further describes validity as concerned with truth value, i.e. if conclusions are

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⁵This percentage belongs to NorgesGruppen, which is the "umbrella" organization of five grocery chain stores in Norway, and ASKO is the wholesaler for all of these stores.
correct, and also with whether methods, approaches, and techniques relate to what is being explored.

According to Saunders et al. (2009) there are four factors that can affect the reliability of a research, namely participant error, participant bias, observer error, and observer bias. According to Robson (2002), participant error occurs when external factors influence the participants’ answers. Participant bias happens when the interviewee holds back information and do not answer questions completely. Observer error and bias are closely connected in that observer bias leads to observer errors when the researchers’ subjective biases prevent them from making objective observations (Mitchell & Jolley, 2010).

In order to reduce the participant error, all the interviews were planned and scheduled in advance to ensure that the interviewees had enough time to answer properly, without interruptions and worries about time constraints. Additionally, the interview guide was e-mailed to all the interviewees, one-two days in advance of the interview, enabling them to prepare for the interview and reduce uncertainty of their details. In regards to participant bias, after having received the interview guide, and before the interview was started, all of the interviewees were asked if their answers should be kept anonymous. None of the interviewees requested this. Further, all interviewees answered the questions seemingly without holding back information or refusing to answer. Further, after chapter 4 – ‘empirical findings’ was written, the text covering each interview was e-mailed to that respective interviewee for approval.

The companies had not put the RFID technology to use in their operations at the time of the interviews, and additionally they are at different stages of implementing/planning of implementing of the technology. Consequently, their answers concerning the RFID aspects were based on plans and thoughts, rather than actual experiences. Also, since the plans on putting the technology to use differed, the perceptions on these matters are under threat of participant bias, and thus the reliability on this matter may be weakened.

To minimize observer bias and errors, the interview questions were open ended in their formulation and in the form of “what” and “how”. Additionally, since the interviewers have limited experience on how to conduct research interviews in the best manner, educational books on research methods, such as Tenenbaum and Driscoll (2005), and Mitchell and Jolley (2010) have been used actively as guidelines, to avoid paying attention only to expected outcomes. This will improve the interviewers’ ability to consider all answers and follow up relevant topics with new questions. Finally, all interviews were recorded to enable re-listening, to ensure that the answers from each actor were correctly cited.

Validity
‘Validity is concerned with the integrity of the conclusions that are generated from a piece of research.’ (Bryman & Bell, 2007, p. 41). Validity is further divided between “measurement”, “internal”, “external” and “ecological”, but Bryman and Bell (2007) emphasize that qualitative studies should be evaluated according to different criteria than those used in quantitative studies. Lincoln and Guba (1985) suggest trustworthiness as a criterion of how good a study is (cited in Bryman & Bell,
In regards to validity, Lincoln and Guba (1985) propose *credibility* as a parallel to internal validity – i.e. how believable the findings are, and *transferability* as parallel to external validity – i.e. do the findings apply to other contexts? (cited in Bryman & Bell, 2007).

Regarding credibility – how believable are the findings. This thesis has interviewed actors in the Norwegian grocery industry that has put RFID pallets to use in their operations. Covered fields are their experiences and perceptions concerning the pallets’ physical aspects, their thoughts, plans, and perceptions of RFID implementation at the pallet level, and their perception of information sharing with supply chain partners. The answers concerning the physical features are based on experiences, and so these answers are likely to be credible in their support or disapproval of the reviewed literature on these features. Concerning the interviewees’ answers on the RFID aspects, these are more likely to have a lower degree of credibility, since these answers are based on mere expectations and plans. The answers on information sharing are seemingly credible, as the interviewees answered straightforward what their thoughts were on this matter.

Concerning transferability – do the findings apply to other contexts? Concerning the physical aspects of the RFID pallet addressed in this thesis, its measures are identical to those of standardized EUR-pallets, and loading capacity requirements are also equal, as mentioned in the literature review. These aspects make it possible, in principle, to do similar evaluations in other areas than the Norwegian grocery industry. In regards to the RFID-related findings, since these are based on plans and thoughts, as mentioned, the transferability to other contexts or areas is more likely to be weakened. However, since the principle of RFID tagging is not bound by national borders or any markets/industries, similar findings can possibly occur in other areas. Concerning the perceptions of information-sharing, this aspect is likely to be affected by different cultures and market structures in different areas/countries, and therefore it may be less likely that these findings will apply to other contexts. Finally, since this thesis focuses on the Norwegian grocery industry, a relatively small market on a global scale, the findings from the study are most likely not significant enough to make them transferable to a worldwide contexts, both because of the size of the Norwegian market, but also due to the great variety in worldwide contexts in this industry.
4 Empirical findings

This chapter presents the results of the interviews held with different producers and wholesalers in the Norwegian grocery industry. First, a brief introduction of the various companies is given. Following this, each company’s view on pallet aspects and RFID/information aspects, respectively, are presented separately, as a narrative. A summary of the findings is given at the end of this chapter.

4.1 Maarud AS

Maarud is a producer of snack products such as potato chips, popcorn, and nuts, and in 2010 the company had a market share of approximately 30.5 per cent (Heckendorn, 2010), and the company’s revenue was approximately 465 million NOK (Purehelp, 2011a). Maarud was the first company to put NLP’s plastic pallet to use in their facilities. Our contact person at Maarud has been the company’s logistics manager, Tor Arne Haugen.

4.1.1 Physical pallet aspects

Maarud uses the RFID pallets within production, storing, and outbound logistics for all of its production for the Norwegian market. The company is finding that the reduced weight of the pallet eases the physical handling and thus improves the working conditions for the employees. Generally, HSE factors have been improved through reduction of dust and splinters in all aspects of its use. Additionally, Maarud’s interviewee mentions food safety improvements as a major reason for using plastic pallets. Compared to wood pallets, the plastic pallets can be cleaned to make sure that all traces of chemicals and other harmful substances are removed. Further, Maarud has experienced reduced downtime in automatic processes due to the consistency of the plastic pallet. In comparison, wood pallets can have parts coming loose and stopping the physical flow.

4.1.2 Information and RFID aspects

Maarud is one of the actors taking part in the pilot study and the RFID readers are installed in the company’s facility. The company will put the RFID technology to use as soon as possible. Firstly, Maarud will use the technology to track pallets into and out of their facility. By using the technology to count pallets in and out of the facility, the company will automate this activity, and thus save labor costs. Today, Maarud uses electronic data interchange (EDI) in its operational interchange of orders and information with their customers. Information regarding the packing list is also interchanged electronically today. Further, Maarud’s interviewee believes that the RFID tag in the future can be a tool to store information regarding products that are loaded on the pallet, but that he is not sure of how far this development has come. However, the interviewee feels that the ERP system already captures and is capable of providing the information that the company needs to per-
form its business effectively. Regarding sharing of information between actors the company feels that the RFID technology will not add more useful information between actors than the EDI system already delivers today. Their view is that RFID technology can be a tool to improve the tracking of pallets and goods, so the right pallet is sent to the right customer, and this way improve the company’s control of its goods.

4.2 KiMs Norge AS

KiMs is, like Maarud, a producer of snack products such as nuts, potato chips, and popcorn. In 2010 the company’s market share was 32.5 per cent (Heckendorn, 2010), making them Maarud’s prime competitor, and their revenue was approximately 548 million NOK (Purehelp, 2011b). KiMs has used NLP’s RFID pallet since it was introduced on the market in 2010. Our contact person at KiMs has been the company’s logistics manager, Geir Stavdal.

4.2.1 Physical pallet aspects

KiMs uses the RFID pallets in production and storing of goods, as well as for its outbound logistics. The interviewee at KiMs emphasized three main reasons for why the company put the RFID pallets to use. Firstly, food safety is enhanced, since the pallets can be kept clean. This drastically reduces risk of dirt and dangerous substances such as diesel residue, which can potentially occur on wood pallets. Secondly, HSE aspects were mentioned as a major reason to change to plastic pallets. For instance, the amount of dust and splinters is significantly reduced compared to their wood counterparts, and the physical handling of the pallet is easier. Third, the short storage time for finished goods at KiMs’, leads to cost reductions from plastic pallets due to the low daily rent these pallets have.

After having put the plastic pallets to use, the experiences from KiMs have been mainly positive with major focus on the cleaning aspects, especially in production and storing. The interviewee points out that the behavior of the plastic pallets is similar to that of EUR pallets, and that it is mainly the hygiene factors that make them better than wood. KiMs has experienced some negative aspects with the pallet as well. In rack storage of heavy products, the corners on the pallets have had a tendency to give in. Special requirements concerning how many centimeters the racks have to go underneath the pallets, and the time consuming process of measuring this, has made KiMs go back to wood pallets for this purpose.

4.2.2 Information and RFID aspects

KiMs has not put the RFID tag in NLP’s pallets to use yet. Still, the interviewee mentioned that the company has been in contact with NLP in regards to pallet tracking through the use of RFID, and their plan is to have the systems up and running during the fall of 2012. The focus with this implementation will be strictly on pallet tracking, and controlling when the pallets are leaving KiMs’ facility. Today, KiMs is registering pallets for transport manually, and the interviewee emphasizes that this process is both time, and labor consuming. Regarding information concerning
what is loaded on the pallets; this will not be loaded onto the RFID tag in the first stage of implementation.

In the long run, the interviewee points out; the perception is that the RFID pallet is likely to be beneficial by containing information concerning the pallets’ content. Today, this information is registered on the SSCC-number on each pallet. Further, KiMs has no immediate plans for putting RFID to use for internal tracking of pallets. The interviewee states that it is way too soon to say anything about this, and that this is a consideration they have not done yet.

Regarding the sharing of information with supply chain partners, KiMs’ respondent highlights that if KiMs would benefit from it, then it would naturally be something they would consider, but that generally it is highly dependent on what the information concerns. Further, the interviewee mentions, the information that potentially will be available through the RFID pallet is already being shared, since it is stored in the barcodes used today. The interviewee says that the efficiency aspect will be the difference, since the information can be shared faster through the automatic processes that the RFID tag allows for.

Finally, KiMs’ respondent sees two potential benefits for the future through the use of RFID pallets. Firstly, KiMs sees a potential in using it to register details on mixed product pallets concerning differences in production dates. This cannot be stored on the barcodes used today. If such information is stored on the RFID tag in the pallet, it will reduce time needed to register and handle the different production date products. Secondly, since KiMs is a producer of snack products, some of the products contain allergens such as gluten and nuts. This information cannot be stored on the barcodes, but the interviewee believes the RFID pallets have the potential to include this information.

4.3 Mills DA

Mills is a producer of fresh produce such as mayonnaise, caviar, pate, and peanut butter. They also produce dry goods, for instance mashed and creamed potatoes. Their revenue in 2010 was approximately 1.6 billion NOK (Purehelp, 2011c). Mills has been using NLP’s plastic pallet since it was introduced to the market in 2010. Our contact person at Mills has been the warehouse manager, Tore Nilsen.

4.3.1 Physical pallet aspects

Mills use the pallet within production, storing and outbound logistics to their customers. The main reason for Mills to put the pallet to use in their operational day to day use is first of all the economic aspect. Calculations done by the company itself show that Mills can save up to one million NOK each year by taking the pallet to use. This measure is based on the pallets longer lifespan and that the company just pay trip cost for each pallet used. Mills is experiencing that the design of the RFID pallet is not suited to their automatic pallet system. Because of this, the pallet can cause some downtime for the automatic system. However, Mills recognize that the lower weight eases the physical handling operations for the workers. Further they see that the pallet improves the HSE conditions. Compared to wood pallets,
the amount of dust, splinters, traces of chemicals, and other harmful substances are reduced.

### 4.3.2 Information and RFID aspects

Mills is using EDI systems to share information with their suppliers and customers. To control the company's resources inside the facility it uses an ERP system. Mills just wants to put the plastic pallet to use and not the RFID technology that follows with the pallet. The company sees the potential in the RFID technology and its advantages, but still believes that the barcode technology is providing the information they need to perform their activities in an appropriate way. They do not want to change a system they are satisfied with to what they see as a new and unexplored technology. Further, Mills' interviewee does not see how the RFID technology can improve their internal processes, because the ERP system they use today provides them with the information they need to operate effectively. When it comes to RFID technology on the pallet level and sharing of information with other supply chain actors, Mills does not see how the RFID pallets can improve and give more important information than the EDI system can provide today. However, the company thinks that it may use the RFID technology in the future to improve the tracking of pallets and goods, and this way improve the control of goods shipped from the facility.

### 4.4 ASKO Norge AS

ASKO is the largest of Norway's four major grocery wholesalers. It is a subsidiary and the distributor for NorgesGruppen, handling the distribution of groceries for all of the chain stores owned by its parent company. Combined, these chain stores make up the largest actor in the Norwegian grocery retail sector. ASKO's revenue in 2011 was 41 billion NOK (ASKO, n.d.). ASKO was early adopters of NLP's plastic pallet, and took it to use in 2010. Our contact person at ASKO has been the logistics manager, Bjarte Grostøl.

#### 4.4.1 Physical pallet aspects

ASKO uses the RFID pallet both for inbound and outbound logistics operations. When pallets are loaded with one product from the vendor and arrives at the facility just for cross docking, the pallet is not reloaded before it is shipped to the retailer. One of the reasons for the company to put the pallet to use was the economic aspects. Because of the longer lifespan and the fact that the pallet is stronger compared to the EUR pallet it can affect the trip cost in a positive way. The HSE aspects concerning less dust and splinters were also important factors for the company's consideration of putting the pallet to use.

ASKO also sees that the lower weight compared to the wood pallet is improving the physical handling for the workers in their facility. The company uses automatic systems for pallet movement in its facilities, and recognizes that the use of plastic pallets compared to wood pallets has reduced the downtime due to reduction of loose splinters and deformed wood pallets. Further, the interviewee mentions that
since the RFID pallets have a higher value than EUR pallets they are more capital binding and, if lost, have a higher compensation fee.

### 4.4.2 Information and RFID aspects

ASKO is using EDI systems to share information with their suppliers and customers. To control the warehouse and sources, they use inventory management systems (IMS) and ERP systems.

The interviewee at ASKO mentions that they have not put the RFID technology to use in their day to day operations, because they believe that the RFID system accuracy is not meeting their requirements. The interviewee states that the reading accuracy is not yet at the level they want, and out of this they do not think that the advantages are good enough for them.

ASKO does not believe that the RFID technology can give the company new information that they do not have access to today. The interviewee believes that the barcode systems the company is using today provide the information they need to operate in an appropriate way. When it comes to sharing of information with other actors in the supply chain, the company believes that sharing of strategic information without price and business conditions will be of interest, but it does not believe that the RFID technology can be a tool to share information in a more efficient way compared to the EDI system.

ASKO believes that sharing of information connecting to the shipment is not a problem by using the already existing technology system like EDI and EAN coding. Still, the company believes that the RFID pallet in the future can be useful to track pallets and goods in the supply chain, in order for the company to increase their control of shipments and goods.

### 4.5 COOP Norge Handel AS

COOP is the second largest grocery wholesaler and retailer chain in Norway. COOP handles the distribution of groceries for all of its own stores. The chain’s revenue in 2011 was 30 billion NOK (COOP, n.d.). COOP was, together with Maarud, one of the companies that took NLP’s plastic pallet to use in the initial pilot project in 2010. Our main contact person at COOP was the logistics director deputy for COOP Norge, Rune Rørvik. Additionally, Marianne Svendsen, outbound logistics manager for COOP Trondheim, and Svein Trondsen, inbound logistics manager for COOP Trondheim took part in the interview with COOP.

### 4.5.1 Physical pallet aspects

COOP uses NLP’s RFID pallets in all areas of goods handling. The interviewees from COOP emphasized that they are experiencing an increasing number of suppliers that are putting the RFID pallets to use. For the future they hope to be heading in direction of one pallet standard, instead of the variety of pallets being used at present. The COOP interviewees pointed towards HSE elements such as reduced handling weight, less dust and splinters, and reduced levels of noise, as the main rea-
sons to put the pallet to use. Further, the interviewee from inbound logistics at COOP Trondheim highlighted that the pallets’ reception at the store level is so far only positive. A lot of pallets are shipped, loaded only with one product kind, so they are shipping plastic pallets to the store level already, even though there is no RFID tracking of the pallets at the store level. This potential element of risk is solved through sending an invoice to the receiving store when the pallets are shipped. The store then pays a deposit of 400 NOK per pallet, and the amount is credited when the pallets are returned. Nevertheless, the store level within COOP has given the plastic pallets a good reception so far. For instance, the pallets can be moved directly to the cold storage when they are received at the loading dock, and eased cleaning keeps the pallets free from dirty and harmful substances.

COOP also had some negative experiences with the plastic pallets when they first put them to use. This was concerning storing racks with brackets in their storage facilities. They experienced that the pallets sometimes was bent downwards when they were heavily loaded. However, this problem has been solved by positioning cross bars in the storing racks in a correct manner.

### 4.5.2 Information and RFID aspects

COOP is one of the main actors in NLP’s RFID pilot project. The company is using an ERP system to control their resources. COOP has not put the RFID technology to use yet, but currently the company is building a new distribution center in Oslo, where the RFID pallet will be used for internal tracking. At COOP’s distribution center in the Trondheim region, there is a pilot project under planning in cooperation with TINE Trondheim. This pilot project is going to focus on improvement of receiving processes concerning chilled dairy products. The RFID pallet will hold information about what products it is loaded with. By using RFID-reader portals in the receiving halls, the products on the pallet will be automatically registered and the IMS will be updated when the driver pulls the RFID pallet through the portal. The interviewee from inbound logistics highlights that with this system they have to trust that the registered number shipped is correct. Even so, COOP will perform control checks to register potential deviations from the order.

At present, the interviewees mention that COOP is struggling with accumulation of goods at the receiving docks at their distribution centers. This leads to problems when it comes to shelving and prioritizing of goods. Their goal is to reduce receiving and identification time through the use of RFID-reader portals in these operations.

Regarding sharing of information, COOP is currently using electronic packing lists from its suppliers. The interviewees do not see what potential information the RFID technology on the pallet level can provide, that the current systems such as electronic packing lists and barcodes, cannot. Even so, they mention that barcodes are easily damaged and that the RFID tags in this matter have a big advantage.

Finally, the logistics director deputy at COOP wonders how long it will take to implement the use of RFID technology through the supply chain. He points out that through his 20 years of working in this industry, he still sees a lot of suppliers struggling with proper barcode labeling of products.
4.6 TINE SA

TINE is the largest dairy company in Norway, cooperatively structured, and owned by the dairy farmers. TINE’s revenue in 2011 was 19.4 billion NOK (TINE, n.d.). TINE’s market share of all milk delivered from dairy farmers was 82 percent in 2010 (Statens landbruksforvaltning, 2011). Our contact person at TINE has been the development manager at Tine distribution, Terje Bye.

4.6.1 Physical pallet aspects

TINE uses the RFID pallet in their outbound logistics from their warehouse and to their customers. Internally, the pallet is used minimally due to its daily rent. TINE has used the pallet since it was introduced on the market. The ability to clean the pallet creates opportunities in terms of enabling its use in TINE’s production areas, where hygiene requirements are crucial. In regards to HSE factors, TINE has mainly automated processes, so physical handling is not a major concern.

4.6.2 Information and RFID aspects

TINE has currently not put the RFID technology in the pallet to use, but the interviewee points out that they are participating in a pilot project called “MatID” (food ID), together with COOP, NLP, and with scientific actors such as SINTEF – the largest independent research group in Scandinavia, and NTNU – Norwegian University of Science and Technology. This project is related to new applications and resource-saving measures made possible by RFID technology and communication between the actors in the food supply chain (SINTEF, n.d.). In TINE’s case, they will use the RFID tag in NLP’s pallet as a unique ID and connect it to the ERP-system in order to automatically register the goods on the pallet. When fully operational, this system will improve the efficiency in regards to receiving and shipping registration of goods. The interviewee states that better control and reduced need of labor and time are the major factors that will lead to this improvement, as well as automatic updates in the ERP-system.

The interviewee at TINE additionally mentions that the RFID pallet has a great potential in regards to tracking of goods within their own systems, and tracking of where the products were manufactured. In a hypothetical case, he says, this information will help TINE to detect which consignments are affected of any potential quality issues, and help to locate the source of the issue. Thus, they will only have to recall the particular consignments affected by the quality issues.

In terms of information sharing, TINE is very positive, especially when it comes to the “matID” project. The interviewee sees information sharing as an important aspect to increase efficiency. For instance, the interviewee stresses that if the information made available through the RFID pallet is shared among the supply chain actors, they will be better suited to reduce the bullwhip effect, and thus reduce buffer inventory. Regarding the amount of information made available through the RFID pallet, TINE’s interviewee emphasizes that they already have the information,
but storing it on RFID tags will ease the gathering and sharing of information between actors.

4.7 Rieber & Søn ASA

Rieber & Søn (R&S) is one of Norway’s leading food companies. The company has production sites in Norway, Sweden, Denmark, Netherlands, Poland, Czech Republic, and Russia. R&S’s net revenue in 2011 was approximately 4.3 billion NOK, of which 2.1 billion came from sales within Norway (Rieber & Søn, n.d.). The interviewee from R&S has been the company’s warehouse manager, Odd-Gunnar Halsvik.

4.7.1 Physical pallet aspects

R&S uses NLP’s RFID pallets only in Norway, since the Norwegian market is NLP’s only market. The main reasons why R&S wanted to put the pallet to use were food safety and hygiene factors, and that the company perceived plastic pallets as easier to keep clean. The company uses the pallets in areas of production and storing in its factory and when products are shipped to wholesalers. R&S put the RFID pallets to use when they were introduced to the market. The interviewee at R&S mentions reduction of splinters and dust, as well as improved cleaning possibilities of the pallet itself, as areas of improvement compared to the use of wood pallets. Additionally, changing to RFID pallets saved a man-year in sorting of pallets.

R&S additionally experienced some challenges when changing from wood to plastic pallets due to reconstruction requirements of the automatic pallet movement racks within their facilities. Since the plastic pallets’ friction is lower than that of wood pallets, R&S had to double the number of wheels on the pallet movement racks to make the plastic pallets move. Now that the RFID pallets have circulated in the grocery industry for two years, R&S is also starting to experience that some pallets are damaged and do not meet the lifespan promise of 10 years, which was promoted when the pallets were introduced to the market. This situation has led to a reappearance of the company’s need to sort pallets.

4.7.2 Information and RFID aspects

Today R&S use WMS and ERP systems to control its inventory and resources. R&S has not put the RFID technology in the pallet to use yet, but is currently considering it. However, the company still feels that it is necessary to assess and calculate potential return on investments before investing in systems to utilize the technology. Areas where R&S sees potential improvements through putting the RFID-tag in the pallet to use are mainly in regards to transportation picking. Nowadays, it happens that transporters pick finished goods for transportation from wrong areas in the storage facility, and thus get the wrong products. By installing RFID-reader portals at the docking gates and utilizing the RFID tag in the pallets such errors can be eliminated through immediate notification of any such occurrences.
Today, R&S share information with wholesalers regarding how many wood and plastic pallets they are shipping, through an Internet-solution in NLP’s web-pages. The interviewee emphasizes that he knows too little about what opportunities the RFID technology can provide and that he therefore feels wrong to answer the questions on this subject.

4.8 Summary

One finding has been intentionally left out of from its original place in the empirical findings due to the belief that it is worth mentioning, but inappropriate to connect to the interviewee who stated it. It concerns power struggles in the grocery industry, both desires for vertical integration among retail chains, and producers wanting control of their own distribution. This aspect was suggested by an interviewee as a reason for practical problems in achieving information sharing and integration between supply chain actors.

RFID-reader portals and other equipment for use with NLP’s RFID pallets had currently been installed at two of the interviewed actors’ facilities (COOP and Maarud) at the time of the interviews, and one actor (KiMs) plans to install the equipment during fall 2012. A third actor (TINE) is participating in a pilot project related to new applications and resource-saving measures made possible by RFID technology and communication between the actors in the food supply chain, in which NLP’s RFID pallets play a central role.

Mentioned and highlighted physical factors of the RFID pallets have been:

- lower weight, easing physical handling
- Improved HSE conditions
- Improved food safety
- Pallets easier to keep clean compared to wood pallets
- Short storage time, leading to cost reductions due to low daily pallet rent
- Longer lifespan, reducing the need for pallet sorting
- Reduction of downtime in automatic operation systems for pallet movement, due to pallet consistency
- Implementation challenges with fitting automatic operation systems to the pallets
- Recognition of the pallets wearing down after two-three years usage

Mentioned and highlighted RFID/information aspects of the RFID pallets have been:

- Tracking of pallets to/from facility
- Storing of information concerning pallet load on pallet tags
- Reducing time and labor for pallet transport registration
- Disbelief in RFID-readers’ accuracy
- Improvement of goods receiving processes

Mentioned and highlighted information sharing aspects of the RFID pallets have been:
• Both belief and disbelief that RFID on pallet level can improve information sharing
• Information sharing of interest, but dependent on type of information
5 Analysis

This chapter gives the analysis of the thesis. First, the empirical findings concerning the physical aspects of the RFID pallets are assessed against the reviewed literature. Following this, a similar assessment of the information and RFID-related aspects will be performed.

The empirical findings will be assessed against the reviewed literature on the various aspects of the RFID pallets, in order to answer the following research question:

- Do the managerial perceptions support the reviewed literature regarding RFID integrated plastic pallets, and if not, where are the gaps?

5.1 Physical pallet aspects

Drivers for companies

The empirical findings show that two main factors are frequently mentioned as drivers for the actors in regards to why they wanted to put the RFID pallets to use: HSE benefits and economical improvements. These two factors seem to be the main points of interest for the actors, regardless of their supply chain role. However, the producers additionally highlighted food safety in their production phase as a critical factor and that the plastic pallets would be a contributor in this concern.

When comparing the drivers for putting the pallet to use, with the improvements for supply chain efficiency suggested in the literature review, there seems to be a connection in the form of a focus on cost reductions. The findings from the interviews point to the fact that the efforts of improving efficiency connect to reductions in pallet shrinkage and pallet trip cost. Also, a reduced need for resources to sort pallets is mentioned as an area in which actors can reduce costs. This connects to the prolonged lifespan of the RFID pallets compared to EUR-pallets, and appearance consistency.

RFID pallets’ physical implications on operations and efficiency

The following features concerning the RFID pallets’ physical implications on operations for supply chain actors were addressed in the literature review: Automatic operation systems, physical handling aspects (Sara, 2009), and holding of goods (NLP, 2010).

Automatic operation processes

Sara (2009) highlights the potential to reduce downtime in automatic operation processes when changing from wood to plastic pallets. The plastic pallets’ behavior can vary depending on the design and functionality of the automatic systems. Some actors experienced challenges of friction and pallets getting bent when implementing the plastic pallet in their automated systems. However, after dealing with these challenges, the experiences among the majority of the actors are; reduced downtime and fewer problems with the automated rack systems in which the pallets are used, than when using wood pallets. Wholesalers and producers both highlight the
improvements that the plastic pallets lead to in regards to automatic operation processes, thus indicating that the managerial perception is in line with the literature. Further, these findings suggest that actors can benefit from plastic pallets in their automatic operation processes regardless of whether they are producers or wholesalers.

An additional observation brought forward by some producers, is the dramatic hygiene improvements that follow when changing from wood, to plastic pallets. The possibility to clean them allows the producers to utilize the plastic pallets in production operations, instead of having to change between different load carriers in their operations. This element has not been addressed in the literature review. However, it gives an indication that producers can achieve efficiency improvements and a more streamlined flow of goods within their facilities, through reduced time spent on loading and unloading of pallets.

*Physical handling of pallets*

The lower weight of plastic pallets compared to wood pallets is highlighted by all but two interviewees as easing physical handling operations. One of the interviewees that did not highlight weight as an essential factor stressed that this was connected to the fact that virtually all of their pallet handling was performed automatically. Reduced pallet weight leads to a reduced physical strain for the workers that handle the pallets, thus improving HSE conditions. In addition to reduced pallet weight, HSE improvement such as less dust in the facility and general improvement of hygiene are emphasized by all the interviewed actors as benefits achieved from implementing RFID pallet in their facilities.

Assessing HSE conditions against efficiency factors is hard to quantify, something the interviewees also emphasize. Still, it is reasonable to draw a connection between the employees’ working conditions and their ability to do their job efficiently. Even though the mentioned aspects are hard to quantify and are seen as indirect impacts on efficiency, their importance should not be dismissed.

Sorting of pallets is another ‘physical handling’ issue of importance from implementation of plastic pallets, not addressed in the literature review. Some actors see a potential to reduce labor resources needed for this operation, since the implementation of the RFID pallets can reduce the variety of pallets in the supply chain. Additionally, the prolonged lifespan of RFID pallets compared with EUR pallets is mentioned as an aspect that reduces the need to sort destroyed or damaged pallets. However, these features were only emphasized by two interviewees, limiting the point’s significance. One of the interviewees also stressed that after two-three years of usage, the RFID pallets now were starting to show clear signs of wearing, and some also being broken. This situation has led to a reappearance of the company’s need to sort pallets. This latter point raises questions regarding the announced 10 year lifespan of the RFID pallets (Haugdahl, 2010). Although only one interviewee mentions the problem, it is still worth paying attention to.

*Holding goods*

This activity from Arnold et al. (2012), mentioned in the warehouse activities was not mentioned in any detail as a major area for improvement by the interviewed actors. Indeed, the only aspect mentioned in regards to holding of goods was not
related to static storing, but storing in racks. KiMs and COOP highlighted that heavily loaded pallets in storing racks have had a tendency to give in or bend downwards. In fact, the interviewee from KiMs highlighted that they had gone back to using wood pallets for such heavily loaded storing units. COOP on the other hand, solved the problem by positioning cross bars in the racks in a correct manner, preventing the downward bending of the pallets from occurring. Summarized, the managerial perceptions do not seem to view the RFID pallets as an important factor in regards to efficiency in holding of goods.

Summarizing all the physical implications of the RFID pallets, the managerial perceptions concerning the benefits that the RFID pallets can provide seem to vary between the interviewed actors. Nevertheless, the overall managerial perception seems to be supportive of the reviewed literature on how the physical characteristics of the RFID pallets can contribute to improvement of supply chain efficiency.

5.2 Information and RFID aspects

None of the interviewed actors had put the RFID technology in the plastic pallets to use at the time of the interviews, and thus their opinions and perceptions regarding the following elements are based on their plans, thoughts, and previous knowledge on the matter. This factor had to be considered when investigating the actors’ perceptions concerning these aspects’ contribution to supply chain efficiency.

RFID aspects’ implications on operations and efficiency
The following RFID implications on operations for supply chain actors were addressed in the literature review: Receive goods (Jiang-Liang & Huang, 2006), dispatch shipment (Swedberg, 2011), and information sharing (Swedberg, 2011).

Receive goods
Concerning receiving of goods, there is a clear difference in regards to what the producers and wholesalers see as benefits they can achieve through implementation of the RFID technology on the pallet level.
Producers in the grocery industry receive a lot of their raw materials on wood pallets from abroad, and the dairy producer TINE additionally receives its main raw material, milk, from tanker trucks. This situation creates a limitation for the producers concerning their ability to utilize the RFID technology of the plastic pallet in their receiving of goods. It is reasonable that such a limitation affects the producers’ perception of how fruitful they find the overall potential of the RFID pallet. Thus, it is also reasonable to assume that if the producers do not see a financial potential in the technology, their willingness to invest is reduced.

In contrast to the producers’ situation, the wholesalers are able to utilize the RFID aspects in their receiving of goods, since they receive goods on plastic pallets from the Norwegian producers that have put the pallets to use. Still, the perceptions of the two wholesalers are divided concerning the potential benefits of the pallets’ RFID aspects. COOP highlights that their goal is to reduce receiving time through the use of RFID-reader portals in their receiving halls, a point that is in accordance
with the literature on receiving of goods. ASKO, on the other hand, believes that the reading accuracy of the RFID system is not meeting their requirements, and further that the barcode systems they currently use give them the information they need to operate in an appropriate way.

The empirical findings concerning RFID pallets’ potential benefits in receiving goods indicate, firstly, that a company’s role in the supply chain is highly significant as to whether the RFID pallets can contribute to efficiency improvements in this activity. Secondly, the findings show a tendency towards disagreement among the wholesalers, to whether RFID utilization at the pallet level can improve efficiency in receiving of goods.

Dispatch the shipment

The interviewees’ answers concerning the potential of the RFID aspects of the pallet seem of support the literature regarding the dispatching activity. Three actors (ASKO, Mills, and KiMs) mention the possibility of tracking pallets and goods through the supply chain as a way to increase the control and accuracy of their shipments. Additionally, three producers (Maarud, R&S, and TINE) specifically emphasized the potential to control improvements in shipping of goods, as benefits to be achieved through the utilization of the RFID tags in the pallets. It was pointed out that this activity enables the actors to control and ensure that the right pallets are loaded onto the right trucks, thus eliminating the chance of goods being shipped to wrong destinations. Although at different levels of addressing the topic, the different actors seem to agree with the literature, regarding the suggested improvements of efficiency that the RFID pallets provide for activities connected to the dispatching of shipments.

Information sharing

The general opinion among the actors concerning sharing of information to improve supply chain efficiency seems positive, although the nature of the information is emphasized as a critical feature for whether the companies will consider sharing it. This situation may be a consequence of the power struggle mentioned in the summary of the empirical findings. Further, it may be an indicator of the fact that although the academic literature highlights the importance of information sharing and integration to improve supply chain efficiency; it is not necessarily desirable for all actors in an industry.

Swedberg (2011) states that the use of RFID pallets and the software solution systems allows for improved information sharing for the supply chain participants. A general perception among the majority of the interviewees is that they do not see how the RFID pallets can improve the information sharing compared to the possibilities that the EDI systems used today provide. They believe that electronic packing lists shared via EDI give the same opportunity as packing lists encoded on the pallets’ RFID tag, in order to get quick access to shipment information. Thus, there seems to be a gap between the literature on the RFID pallets potential, and the perception among the actors in the grocery industry, concerning the possibilities of information sharing made available by the RFID-technology on the pallet level. Further, this indicates that potential efficiency benefits from the utilization of RFID technology on the pallet level may depend on whether an actor is using electronic or paper packing lists.
In addition to the addressed topics from the literature review, two companies (COOP and TINE), see another potential of the RFID pallets. The two actors highlight the possibility of the RFID technology to track pallets within their own facilities as a means to improve internal operations, and thus to improve the control of internal goods movement. An interesting remark in this concern is that through the interviews, these two companies seemed to be the most active participants in pilot projects and development plans concerning the usability of RFID technology. This may imply that these companies have a better insight to how they can benefit from the RFID pallets. At the same time, it may indicate that they have a more positive attitude in general, since they are participating in projects that they, most likely believe in, and thus that their perceptions might be colored by their active participation.
6 Conclusions and further studies

This chapter gives the conclusions for the research questions and brings suggestions for future research.

6.1 Conclusion

The companies in the Norwegian grocery industry interviewed in this study mention two main factors as drivers for implementing RFID pallets in their businesses: HSE benefits and economical improvements.

Concerning the physical implications of the RFID pallets addressed by the literature in this thesis, the managerial perception is mixed in its support.

- Regarding improvement in automatic operation processes, the managerial perception appears to agree with the literature in that these processes are improved by the pallets’ implementation, through reduction in downtime and fewer problems with automated rack systems.

- Concerning physical handling of pallets, the managerial perception supports the literature and puts additional emphasis on the HSE factors in these activities, which are improved when implementing plastic pallets. An efficiency improvement additionally addressed by the interviewees was the reduced need of labor for sorting of pallets due to pallet consistency.

- Concerning holding of goods, the managerial perceptions do not seem to view the RFID pallets as an important factor for efficiency improvements, indicating a gap to the literature.

The information related/RFID aspects’ implications of the RFID pallet addressed by the literature were perceived by the interviewed actors based on the actors’ plans and thoughts, since they had not put the technology to use.

- In receiving of goods there is a difference between producers and wholesalers in their perception on the possibility to utilize NLP’s RFID pallets. Producers receive much of their raw material on wood pallets from abroad, eliminating their use of the RFID pallets in the receiving of goods. The wholesalers are split in their belief on whether RFID at the pallet level can improve efficiency in their receiving of goods, compared to today’s use of barcode systems. All in all, the managerial perception is therefore not clear and does not underpin the literature.

- Concerning dispatching of shipments, the reviewed literature suggested that information-related activities would be automated, thus improving efficiency and reducing risk of human errors. The managerial perception supports this literature, although different aspects are mentioned as areas of
interest, namely control of pallet tracking, and control of shipments being sent to the right destination.

- Regarding information sharing, the literature suggests that it is essential to optimize the supply chain. The managerial opinion agrees with this, but highlights the fact that the nature of the information is determining whether they will consider it. As mentioned in the summary of chapter 4, factors such as power struggles also effect this situation.

6.2 Suggestions for further studies

The focus of this study has been on the grocery industry, the Norwegian industry in particular. Thus, a study of broader context, applying the research methods to a larger area would be of interest to investigate if similar findings can arise elsewhere. Further, going beyond the boundaries of the grocery industry to perform a similar type of study in other industries will improve the ability to pinpoint transferability, as well as providing the opportunity to discover new differences or similarities between industries.

Since the RFID tag in the plastic pallets in this study, has not been put to use at present, a further study could be done to identify the managerial perceptions based on experiences, in order to get a more accurate picture. Additionally, this research has not included the retail store level, thus limiting the impact of the thesis. Further research should include this level when this level has put the pallet to use, and could also, in order to get a broader and more nuanced picture on the topic, include actors in the industry that have not put the plastic pallets to use. Also, since this thesis has not included cost-measures of implementation, this could also be an area of interest in future research on the subject.

Methodologically, the thesis was constrained to an extent by a scarcity of resources on the topics being researched and therefore a limited literature review.

Finally, this thesis has had an inductive approach, leading to findings that give suggestions for further studies, rather than claiming to establish truth. Thus, further deductive research could be done to investigate whether the suggested outcomes of this thesis can be generalizable to other industries and countries.
References


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Appendices

*Appendix 1 - Interview guide*

**General**
1. What was the reason(s) for your company to put the pallet to use?
2. What future expectations do you have with the use of the pallet?
3. In which areas of your operations are you using the pallet?
4. For how long have you been using the pallet?

**Pallet**
5. If you put the RFID aspects of the pallet aside, and only focus on its physical attributes, how has the pallet affected your operations?
   - HSE elements?
   - Positive aspects?
   - Negative aspects?
6. Referring to how you are utilizing the pallet today, do you see any efficiency benefits arising from its use?

**RFID**
7. Have you put the RFID technology in the pallet to use?
   - If not, how do you picture your internal use of the technology?
8. What information do you plan to store/gather from the RFID tag in the pallet?
   - How will you use this information to improve internal efficiency?
9. How do you think the RFID technology in the pallet can affect your operations?

**Information sharing**
10. Generally, what is your view on information sharing with other companies in your supply chain?
11. Would it be appropriate for you to share information made available via the RFID pallet with your supply chain partners?
   - Why/why not?
12. Will the RFID technology in the pallet help you to get access to new information that could result in efficiency gains?
## Appendix 2 - Details concerning interviews

<table>
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<tr>
<th>Company</th>
<th>Company type</th>
<th>Name</th>
<th>Position</th>
<th>Interview type</th>
<th>Date</th>
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<td>Maarud AS</td>
<td>Producer</td>
<td>Tor Arne Haugen</td>
<td>Logistics manager</td>
<td>Telephone</td>
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<td>25 min</td>
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<td>KiMs Norge AS</td>
<td>Producer</td>
<td>Geir Stavdal</td>
<td>Logistics manager</td>
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<td>20 min</td>
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<td>Mills DA</td>
<td>Producer</td>
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<td>Warehouse manager</td>
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<tr>
<td>ASKO Norge AS</td>
<td>Wholesaler</td>
<td>Bjarte Grostøl</td>
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<td>Rieber &amp; Søn ASA</td>
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<td>Odd-Gunnar Halsvik</td>
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