Reduction of wastage costs for products with short shelf life
- A case study on the Swedish division of the global dairy company Arla Foods

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Abstract

Background – inventory management theory has in the past been focused on traditional engineering industries. These theories are not completely applicable on industries such as FMCG where the main objective is to avoid obsolescence and not tied-up capital. A part of the FMCG industry that is especially pressured by short shelf lives is the food industry. The food industry has also the disadvantage that the customers demand instant deliveries, which makes production to order impossible. Arla Foods is a dairy company that is struggling with high and increasing wastage costs. The wastage cost is generated from products where last sales date is exceeded and Arla Foods CSE therefore has to trash the products even if the best-before date is still valid. These costs need to be reduced on both short and long term. Hence Arla Foods is perfect as a case company for this study.

Purpose – the ulterior purpose of this study is to seek if the current theory is applicable on the food industry. This is investigated through a case study at Arla Foods with the following questions asked: Which factors drives wastage costs at a global dairy company such as Arla Foods? How do the factors relate to each other? Which actions could be taken to reduce the wastage costs at a global dairy company such as Arla Foods? To what extent could these findings be generalizable?

Method – a thorough literature study is conducted to create an understanding of the existing theories. The case study is mainly based on interviews and observations with employees at Arla Foods. Data has been extracted from internal data bases and processed to complement the interviews and observations.

Conclusion – the case company showed that the most significant wastage drivers on an article level were forecast deviations and batch size/delivery frequency. However, the main wastage drivers at Arla Foods were nothing that could be found in neither supply chain management nor inventory management theory – this was instead problems related to work process, organization, communication and strategy. Suggested solutions to these problems are among others:

- Going through the worst performing articles’ set-up in a structured way.
- Making sure that there exists a clear process and that all employees are educated in it.
- Having a back-up plan on what to do with excessive inventory.
- Using follow-up reports as tools to take action from.
When these problems have been solved, Arla Foods can instead focus on planning principles such as taking steps towards a more integrated collaboration with their customers via Efficient Consumer Response.

The findings are not proved to be general in any way, but the conclusion of the report still states that there is a high probability that these findings could be applied on other companies within the food industry in general and within the dairy industry in specific. If this is the case, then it is shown that the current theory lacks several aspects when it comes to food industry – aspects that maybe do not have the same importance within most of the traditional engineering industries.

Originality – the literature review conducted before the case study did not show any other case study or research that has made an equally broad overview. Earlier studies have mainly been focused on that the food industry is in need of customized planning principles and systems. That research has in the end advocated implementation of Efficient Consumer Response or similar.

Key-words: inventory management, food industry, wastage
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List of abbreviations

- **CSE**: Consumer Sweden, a regional division of Arla Foods (explained at p.2).
- **ECR**: Efficient Consumer Response, an inventory management philosophy (p.13).
- **EOQ**: Economical Order Quantity, an inventory management philosophy (p.12).
- **ERP**: Enterprise Resource Planning, a data system for planning (p.3).
- **FMCG**: Fast Moving Consumer Goods, a common denotation of a group of similar industries (e.g. food and apparel) (p.2).
- **FVC**: Färskvarucentral, a regional distribution centre for Arla Foods’ products (p.2).
- **HDS**: Heavily Discounted Sales, used by Arla Foods to avoid wastage (p.30).
- **KPI**: Key Performance Indicator, a figure which should guide the company (p.2).
- **QR**: Quick Response, an inventory management philosophy (p.13).
- **ROL**: Re-Order Level, a mechanism controlling when to replenish (p.15).
- **ROP**: Re-Order Point, a mechanism controlling when to replenish (p.15).
- **SCM**: Supply Chain Management, theory on relationships within the supply chain (p.5).
1 Introduction

This chapter introduces the reader to the reasons why the research is conducted in the first place. The chapter will also include the purpose of the research, research questions and under what constraints the research has been conducted.

1.1 Background

Inventory management has been studied frequently the last 50 years but most of the literature and theories are focusing on how to optimize the inventory levels of product categories belonging to traditional engineering industries. This focus and these theories are not entirely compatible with other types of industries, as for example the FMCG (Fast Moving Consumer Goods) industry which has the same needs to reduce their inventory levels as engineering based companies, but different challenges. A special case of the FMCG industry is the food industry with its unique challenges and in general high inventory turnover rate (Kurt Salmon Associates Inc. 1993). The lack of compatibility originates from a couple of basic differences in the conditions of the industries.

The first difference is that most industries share the characteristics that optimization of inventory levels are made to reduce tied-up capital and hence increase the financial performance of the company and free money to other investments. The majority of the products in these industries will not be obsolete before it has spent a relatively long time on stock. However, the food industry, for example, needs to optimize inventory levels because of the fact that they, due to obsolescence, will have to trash all goods that has been on stock for a limited time (Ketzenberg and Ferguson 2008). In certain parts of the food industry, e.g. dairy and meat products, the shelf life for the products is very short.

The second difference is that the food industry\(^1\) seldom can choose to produce to order because the retailers expect to receive the goods within 24 hours after they have placed an order (ProjectManager-I Arla Foods 2012). This is because the retailers experience a high demand with difficulties to forecast (the demand pattern could be affected by factors such as weather (Planner-I Arla Foods 2012)). In addition to this, changes in demand can occur faster than the production can keep up, while people at the same time do not have any acceptance at all for stock outs at their local retailers. The customers do not want to stock the goods themselves because of the same reason as the producer – the short shelf life of the product. The short shelf life of the products makes the volatility more damaging and the problems more urgent.

Both of the above mentioned differences generate questions on how companies within the food industry can work with reducing wastage, due to expired sales date, of finished goods. This will be studied through a case study of Arla Foods.

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\(^1\) This paragraph is based on interviews with employees at Arla Foods, but it is interpreted to be general for the industry.
Arla Foods is a global dairy company with its origins in Sweden and Denmark and has today established facilities in over 30 countries worldwide (Arla Foods 2012a). Each market\(^2\) has its own organization with control over sales & marketing, distribution and supply chain management among other things (Arla Foods 2012a). The Swedish branch of the company, Arla Foods CSE\(^3\), has a supply chain consisting of own production facilities and distribution centers called “Färskvarucentraler” (FVC). All planning and forecasting, aimed at optimizing inventory levels at the FVC’s, is centralized to Arla Foods CSE’s head office in Stockholm and this case study will therefore proceed from the department of Planning & Forecasting. One of the elevated KPIs\(^4\) that Planning & Forecasting is measured on is cost of wastage at the FVCs (Jardal Arla Foods 2012). The wastage cost is generated from products where last sales date is exceeded and Arla Foods CSE therefore has to trash the products even if the best-before date is still valid. The expiration of the sales date is stipulated in customer agreements to secure that the retailers have a certain number of days to sell the product before the best-before date expires (Jardal Arla Foods 2012).

In combination with the financial objective to reduce the costs related to wastage, Arla Foods has also a sustainability policy and a trademark that says Closer to Nature (Arla Foods 2012c). This opens up another interesting viewpoint: the Earth’s population is increasing and food becomes more and more dependent on scarce resources, so trashing unsold food will not only affect Arla Food’s income statement, but also use resources that could have been used on another time or another place.

1.2 Problem definition
The case company, Arla Foods CSE, has been struggling with high and increasing wastage costs the last couple of years and has tried different actions to reduce the costs with no apparent result (Jardal Arla Foods 2012). With the current unstable economic situation and an increasing competition at the Swedish market, unnecessary costs have to be cut. A reemerged and even stronger attention has been directed on reducing the wastage cost to a more acceptable level.

The problem on-hand will, based on these circumstances, be to reduce the wastage costs with both an immediate short term effect as well as a sustainable long term effect.

1.3 Purpose of study and research questions
The purpose of this specific case study is to pin-point the wastage cost drivers at Arla Foods CSE and find ways to neutralize them with counter-actions so that the end result will be reduced wastage costs for Arla Foods CSE. The additional purpose of the academic thesis is to generalize the results of the case study to make them applicable on other companies facing the same type of problems in industries with a need of high inventory turnover.

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\(^2\) One market consists of one or multiple countries where Arla is active.
\(^3\) CSE = Consumer Sweden.
\(^4\) KPI = Key Performance Indicator, a measurement to capture the company’s current performance and trend.
The purpose will be obtained in three steps. The first step is to collect information to find what factors that drives wastage costs and value them against each other. The second step is to do thorough analysis of what actions could be done to reduce the costs. The third step is to analyze to what extent the findings could be generalized.

The purpose could be narrowed down to four research questions which this study will answer:

- Which factors drives wastage costs at a global dairy company such as Arla Foods?
- How do the factors relate to each other?
- What actions could be taken to reduce the wastage costs at a global dairy company such as Arla Foods?
- To what extent could these findings be generalizable?

1.4 Delimitations and limitations

The term wastage will in this report only be defined as finished products that are being trashed at the FVCs due to expiration of last sales date unless it is clearly specified otherwise. This means that all goods that is trashed due to damages, poor quality or other factors anywhere inside or outside of the FVCs will be excluded from the term “wastage”.

Arla Foods CSE has chosen to divide its products into two separate categories because of differences in large part of the value chain from production to planning to sales. The two categories are:

- **Milk** - products with low value added, mostly standard milk- and cream products.
- **Special Products** – all other products e.g. soups, yogurts, sauces and juices.

In addition to these two categories Arla Foods also produce cheese products, but this is a globally controlled category and will hence not be included in the report at all. This case study will have its main focus on the category Special Products since this category is significantly smaller than Milk in turnover, but still lies much higher in wastage costs. All factors and actions considered will originate from Special Products, but could still be relevant for Milk.

The study will not go deep into details where Arla Foods CSE already has employed specialists; perhaps the most distinct example of this is how the forecasting models are built.

Arla Foods CSE is currently undergoing a change of Enterprise Resource Planning (ERP) system, the change is planned to occur just before the turn of the year 2012/13. As their need to reduce wastage cost is urgent, the study will be conducted under current circumstances. However, after the actions have been suggested their adaptability to the new ERP will be analyzed by Arla Foods CSE. The result of that analysis will lead to a planned change of set-up, either of the action or of the ERP system itself. The general point of view from Arla Foods CSE is that the change of ERP system will not be a major problem from this perspective.
The report will not include any absolute cost figures due to a request from Arla Foods CSE to keep them confidential. The costs will when possible be described in relative terms. Hence no charts will have units on the axes.

The planners’ and project managers’ identities will not be connected to specific statements in the report. This decision was made to win their trust and create the feeling that they could be open with their opinions and thoughts. The sources will be named “Planner-I”, “Planner-II” etc. A list with the sources real names will be included in the bibliography in alphabetical order without connection to the numerical sequence of the sources.
2 Theoretical frame of reference

This chapter will guide the reader through the theoretical frame of reference used in this research. Some areas will be used in the analysis and some areas serve as background information. The literature review is based on both educational books and scientific articles.

2.1 Introduction

The theoretical frame of reference is meant to give the reader a deeper understanding on the basic foundation of important theories and concepts as well as on theories more directly applicable on the scope of this thesis. The review of current theory will start off with the broadest framework applicable on the problem formulation of this thesis – supply chain management. It will then follow a narrowing path down to a more specialized field. This could be illustrated as a funnel or a pyramid turned upside-down. Each area in the theoretical frame of reference consists of a mix between generally applicable information, from textbooks and broad research articles, and research specialized on FMCG and/or food industry.

Research articles on both food industry and grocery industry have been included in this theoretical frame of reference. Both industries are handling the same goods and the interpretation used is that the difference between the two lies in which step in the value chain you want to consider the problem from. The food industry has the food producer in focus and the grocery industry has the food retailer in focus, both facing the same problems with short shelf life on products. Arla Foods is both a producer of food and a distributor of a wide variety of products, which gives even stronger incentives to use both sets of theories in this study. Hence both food industry and grocery industry will be referred to as food industry from now on in the report.

2.2 Supply chain management

Supply chain management (SCM) is theory on how interaction and relationships between parties within the supply chain should be managed (Mentzer, et al. 2001). This is important for the purpose of this thesis since wastage is the result of a problem, miscalculation or regulation either downstream or upstream in the supply chain.

SCM is a relatively new construct and was mentioned at first in 1982 by authors Oliver and Webber, but did not become frequently used and discussed until the 90s (Lummus and Vokurka 1999). However, the phenomenon and thoughts that the term is reflecting is older than that. One of the first known researchers to discuss the interrelationship between different parts of the supply chain was Jay Forrester who wrote this in 1958:
“Management is on the verge of a major breakthrough, in understanding how industrial company success depends on the interactions between the flows of information, materials, money, man power and capital equipment. The way these five flow systems interlock to amplify one another and to cause change and fluctuation will form the basis for anticipating the effects of decisions, policies, organizational forms and investment choices.” (Forrester 1958, p.37)

But why did SCM evolve under the 80s and become so popular under the 90s? Lummus and Vokurka (1999) listed three crucial reasons:

1. Companies had previously been vertically integrated and hence controlled the whole supply chain. Increased specialization created foundations for developing relationships with suppliers and customers specialized in their field. All parties soon learnt that success for one party meant success for the other party.

2. Globalization and growth of developing countries created increased competition which both created possibilities with an increased population of suppliers and customers as well as it put pressure on companies to become more efficient with low/no inventory.

3. Sub-optimization surfaced as a problem when companies started to review their total costs. One example of this could be purchasers buying cheaper material to save money but instead raising the production cost more than the saving they enjoyed.

To understand what SCM actually is, how Forrester’s text fit in and to appreciate the width of the term it is necessary to start from the beginning explaining what a supply chain is.

2.2.1 Definition of supply chain and SCM
The term supply chain is well-discussed and the research society in general agrees that the term includes all external and internal parties that take part of the transformation from raw material into a finished product in the hands of the end customer (Londe, J and Masters 1994). (Cooper and Ellram 1993). Mentzer et al. (2001, p.4) defines the supply chain as “a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances and/or information from a source to a customer”. A similar definition to this is used in educational literature at University level (Chopra and Meindl 2001). Mentzer et al. (2001) also states that the supply chain could either be a straight line from suppliers to customers or an “ultimate” supply chain including all support functions as well (see figure 1 and 2).

![Figure 1 - a supply chain visualized as a straight line from supplier to customer. Adopted from Mentzer et al. (2001).](image-url)
Even though a consensus exists on how to define the supply chain, there are several interpretations of what supply chain management is. Many researchers have collected published definitions to find differences and similarities in how the research society uses the term (Cooper, Lambert and Pagh 1997) (Mentzer, et al. 2001) (Bechtel and Jayaram 1997). Mentzer et al. (2001) distinguish three separate categories to sort in the different definitions. SCM could either be interpreted as a management philosophy, a set of activities to implement a management philosophy and/or a set of management processes. Bechtel and Jayaram (1997) are instead interpreting the different definitions as a development over time, starting with definitions describing what they call “chain awareness school” and then adding new dimensions which are reflected by definitions in the scope of “linkage/logistics school”, “information school”, “integration school” and “future”.

Despite these inconsistent definitions the research society agrees on the basics (Cooper, Lambert and Pagh 1997):

- SCM evolves through intra- and inter-organizational integration and coordination of all tiers of suppliers and customers.
- Independency of organization does not act as a border for SCM.
- SCM includes flow of material, services, information and all related activities and operations.
- The objective of SCM is to add to the customer value while at the same time increase the cost efficiency.
Council of Supply Chain Management Professionals conducted a survey to explore how their members and actual practitioners interpreted SCM. The answers that came back were that 72.6% were of the opinion that the primary role of SCM was to be a combination of strategy and activity. 98.4% of the respondents answered that their work with supplier and customer collaboration was encompassed (80.8%) or influenced (17.6%) by SCM (Gibson, Mentzer and Cook 2005).

2.2.2 SCM in the food industry

Working with SCM in the food industry is different from working with SCM in traditional engineering industries which makes it hard to adopt the same models on both situations (Gerogiadis, Vlachos and Iakovou 2005). The food industry has very strict legislations for everything from handling the goods to transportation of the goods, but the most different factor from other industries is the perishability of the goods that creates a new and higher level of uncertainty for both suppliers and customers (Gerogiadis, Vlachos and Iakovou 2005).

Factors such as globalization, mass-customization and the fact that retailers set their own prices and promotions have pushed the demand to become more unpredictable while the production is still relatively inflexible in comparison to what is needed (van der Vorst, van Dijk and Beulens 2001). The supply chains within food industry are often suffering from low investment and few improvement projects (van der Vorst, van Dijk and Beulens 2001). This is because of the margins on the products are so low that the company will need to increase their sales significantly due to the improvement in the supply chain to give a secure return on investments (van der Vorst, van Dijk and Beulens 2001). The effect of a neglected supply chain could however be larger than the companies have estimated (Axtman 2006). Research has shown that one of the most important factors for consumers when choosing where to shop is freshness of the goods (Axtman 2006) and it is possible to draw a direct parallel between the goods’ freshness and the efficiency of the supply chain. An efficient supply chain will reduce lead times and generate higher accuracy in the ordering process, hence leading to a minimized time between production of goods, order from retailer and purchase from customer. This will in turn lead to a maximized freshness of the goods.

2.3 Inventory management

It does not matter which definition you use of SCM, inventory management is one of the main ingredients (Quinn 1997). Inventory management is, as the name implies, a collection of tools and strategies used by companies to handle inventory related questions. Inventory management is an area that historically has been handled inefficiently. Efficiently performed inventory management has been proved to be a key to lower costs and higher margins. The costs can be reduced by 20% in over 90% of the cases without affecting customer service at all (Silver, Pyke and Peterson 1998).

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5 Other answers were a strategy that transcends individual functions (15.6%), a corporate function or activity (9.0%) and something else (2.7%).
One of the first known publications related to inventory management was an article by Harris (1913) discussing order quantities, as reported by Silver (2008). The findings in the article by Harris are still used in educational books as the standard way to determine order quantities (Aronsson, Ekdahl and Oskarsson 2003) (Slack, Chambers and Johnston 2007) (Olhager 2000).

2.3.1 Definition of inventory

Inventory, or stock, could be defined as “stored accumulation of material resources in a transformation system” (Slack, Chambers and Johnston 2007, p.367). A more elaborated definition is “the raw materials, work-in-process goods and completely finished goods that are considered to be the portion of a business’ assets that are ready or will be ready for sale.” (Investopedia 2012). Reading the previous definition makes it obvious that you will need to distinguish different types of inventory. There are several ways to differentiate them:

- **Safety stock/ buffer inventory** – material on stock with purpose to compensate for insecurities in demand and supply (Slack, Chambers and Johnston 2007) (Silver, Pyke and Peterson 1998).

- **Cycle inventory** – material on stock waiting for a full batch to be ready instead of single unit production (Slack, Chambers and Johnston 2007) (Silver, Pyke and Peterson 1998).

- **Decoupling inventory** – material on stock waiting for the next operation, letting different functions, work centers or facilities optimize their operation set-up instead of having a takt time constrained by the slowest operation (Slack, Chambers and Johnston 2007) (Silver, Pyke and Peterson 1998).

- **Anticipation inventory** – material on stock waiting for peaks in demand (seasonal or other) (Slack, Chambers and Johnston 2007) (Silver, Pyke and Peterson 1998).

- **Work-in-process/pipeline inventory** – material that is undergoing transportation either from supplier, to customer or from one operation to another within the process (Slack, Chambers and Johnston 2007) (Silver, Pyke and Peterson 1998).

- **Congestion stock** – material on stock because of that one machine performs operations on several product types, hence one type of product needs to wait while the machine finish the current batch. The size of the stock depends on set-up times for the machine (Silver, Pyke and Peterson 1998).
All of the reasons mentioned above are valid reasons to keep inventory and could e.g. help the company reducing costs related to an insufficient delivery performance (disappointed customers will look for other options) and utilizing economies of scale in the purchasing and production, leading to discounts and shorter periods of set-up. However, inventory drives a lot of costs as well (Slack, Chambers and Johnston 2007):

- Costs for tied up capital when purchasing material and other parts is paid for a long time before the customers pay for the finished goods.
- Storage costs of all types: leasing or buying space, administrative costs, personnel costs, alternative costs for used space etc.
- Obsolescence costs due to that the goods are no longer useable (or attractive to the customer compared to other alternatives) and therefore need to be scrapped/trashed.
- Costs when inventory becomes damaged.
- Costs when inventory gets lost and needs to be replaced.

**2.3.2 Definition of inventory management**
The main part of inventory management is to master the art of weighing above discussed advantages and disadvantages of carrying inventory to find an optimal balance. Silver, Pyke and Peterson (1998) boil down the complexity of inventory management to three main questions that the company should answer given their current situation, strategy and possibilities:

1. How often the inventory status should be determined.
2. When a replenishment order should be placed.
3. How large the replenishment order should be.

Slack, Chambers and Johnston (2007) also pinpoints three decisions:

1. How much to order.
2. When to order.
3. How to control the system.

Both lists are highlighting the decisions of *when?* and *how much?*. The answer to these to questions controls the inventory levels at all times.

However, the answering range is often constrained by one or more factors. Silver (2008) brings up three different types of constraints: supplier constraints (minimum order quantities, pack sizes, replenishment times etc), market constraints (minimum service level to customers) and internal constraints (space limitations, available money, workload etc).
Besides the already discussed costs of holding inventory, there are costs related to the replenishment process itself. To place a replenishment order will of course generate a variable cost for the purchased material, but it will also cause a fixed administrative cost for placing the order, transport the goods, control the goods upon reception, handle the invoice etc (Slack, Chambers and Johnston 2007).

2.3.3 Inventory management in the food industry
The main objective for food producers, suppliers and retailers is to make sure that everything on stock will be sold before the last sales date expires, which puts a lot more pressure on inventory management than in other industries (Ketzenberg and Ferguson 2008). This highlights two factors needed for increased performance and reduced wastage: information sharing and coordination of replenishment activities (Ketzenberg and Ferguson 2008).

2.4 Principles and theories within inventory management
This chapter will continue with more detailed principles and theories providing options on answering the two defining questions of inventory management – *when?* and *how much?*. To answer these questions it is important that the reader bears in mind that it does not exist one solution that fits the complete assortment of a company. However, the assortment is also too large to be managed on an item level (Aronsson, Ekdahl and Oskarsson 2003). That is why it is important to categorize all items, so that similar items can be managed in their own optimal way (Aronsson, Ekdahl and Oskarsson 2003). A simple method of doing this is the ABC classification (Aronsson, Ekdahl and Oskarsson 2003).

2.4.1 ABC classification
The most basic form of ABC inventory classification system is when all items are categorized and assigned a classification (denoted by a letter A, B, C etc.) based on the criteria volume value\(^6\) (Aronsson, Ekdahl and Oskarsson 2003). The next decisions are how many categories there should be and at what values they should be separated. It is normal to use between three or six categories (Silver, Pyke and Peterson 1998). After the classification is decided one will be able to use it when setting service levels, stock control methods etc. based on each group’s specific characteristics. This will provide better result than using the same set-up on all items and be more efficient than assigning each item an individual set-up. However, one criterion might not be enough so ABC classification can also be set up so that multiple criteria can affect the classification outcome. Other criteria that can affect the classification are i.e. frequency, lead time and criticality (Olhager 2000). An example of a more complex model with four criteria has been developed by Teunter, Babai and Syntetos (2010), where they consider the parameters holding cost, order quantity, “cost” for stock out and demand. Another option is to use multiple ABC classifications based on different criteria where each classification controls separate actions.

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\(^6\) Volume value = sales volume \(*\) item value (Aronsson, Ekdahl and Oskarsson 2003).
2.4.2 Decision models answering how much to order and when

The answers on these two questions are highly correlated. Answering *how much?* will often give you the answer of *how often?/when?*. When it comes to the question of how much to order there are two methods that are mentioned and used more often than others both in industry and amongst researchers; Economical Order Quantity (EOQ) and Quick Response (QR) (Zinn and Charnes 2005). A variant of QR specified for the food industry is Efficient Consumer Response (ECR) (Fiorito, May and Straughn 1995). All methods will be described and compared in this section.

**EOQ** is a method that can be dated back almost 100 years to an article by Harris (1913). However, the method did not become popular until it was re-introduced by R. H. Wilson 20 years later and that is why the formula that calculates EOQ is referred to as the Wilson formula (see equation 1). EOQ considers the factors: fixed order cost (S), annual demand (D) and annual inventory holding cost per unit (H). The goal is to find the most cost-effective order quantity ($Q^*$) with aspect to the total cost. The equation can be solved given a few assumptions and simplifications (Aronsson, Ekdahl and Oskarsson 2003):

- The demand is constant and known.
- The order cost is known and independent of the order quantity.
- The inventory holding cost is constant and known.
- The whole order quantity is delivered at once.
- The purchase price is independent of the order quantity.
- There are no capacity constraints in storage space, budget, durability etc.

And the formula that solves the equation is:

$$Q^* = \sqrt{\frac{2DS}{H}}$$

*Equation 1 – the Wilson formula (EOQ)*

To cope with the weaknesses that the assumptions and simplifications create, variations of the Wilson formula have been developed so that these factors can be incorporated as well (Olhager 2000). However, the main problem that has been defined is the insecurity of how to calculate the order cost and inventory holding cost.

Since the original formula is defined under the assumption of a stable demand, the interval between order placements is simply the demand divided with $Q^*$. 
QR is a Just-In-Time inspired method aimed at shortening lead times and reducing the inventory on hand (Zinn and Charnes 2005). The method was first used by the apparel industry that had problems with lead times that were so long that they needed to place the orders long before the demand existed which caused problems with both excess inventory and stock outs (Iyer and Bergen 1997). The main idea of QR is that the company upstream in the supply chain has access to instantaneous sales data from their customers via Electronic Data Interchange (EDI) and can adjust their production in line with the actual demand (Fiorito, May and Straughn 1995). The goal is to continuously deliver goods in smaller batches more often to reduce inventory levels (Iyer and Bergen 1997).

ECR is “a grocery-industry strategy in which distributors and suppliers are working closely together to bring better value to the grocery customers. By jointly focusing on the efficiency of the total grocery supply system, rather than the efficiency of individual components, they are reducing total system costs, inventories, and physical assets while improving the consumer’s choice of high quality, fresh grocery products.” (Kurt Salmon Associates Inc. 1993, p.1). ECR is built similar to QR with the main idea of a closer collaboration between the companies within the supply chain through shared sales data and an automatic replenishment system negotiated (Fiorito, May and Straughn 1995). The reason for using ECR instead of QR in the food industry comes from the lower number of items and the more rapid turnover. Lead times are in general shorter, ordering frequency is higher, shelf life is shorter and product life cycle longer and this causes differences in the behavior of the parties (Kurt Salmon Associates Inc. 1993). The food industry also has a greater need for continuous deliveries in even smaller batches than other industries and the production can shift more easily. Another term that is similar to ECR is Vendor-Managed Inventory (VMI), but the difference between the two of them are vague and it is not clearly defined how they are related to each other (Disney and Towill 2003).

The main difference between EOQ and QR/ECR is that EOQ considers both ordering costs and inventory holding costs while QR/ECR only focuses on inventory holding costs (Zinn and Charnes 2005). This means that EOQ in general is a better option if the ordering cost is high and QR/ECR in general is better if inventory holding costs are high, so each method could be applied in separate situations and be the best option. Advocates of always using QR/ECR have focused the criticism of EOQ on that..:

- …inventory holding costs are often underestimated and only calculated as a standard percentage of purchase price not considering the need for extra facilities or risks for obsolescence due to substitutes etc (Slack, Chambers and Johnston 2007). QR/ECR has the objective to minimize inventory and hence the connected costs/risks.
• ...EOQ only gives the best option given the current cost situation instead of being pro-active and working actively with cost reduction of ordering and inventory holding costs (Slack, Chambers and Johnston 2007). QR/ECR is on the other hand a system designed to minimize and almost eliminate the ordering cost by using EDI and automatic deliveries.

• ...EOQ is focused on optimizing ordering of individual items and does not take ordering synergies for similar products at the same time and the same supplier into account (Slack, Chambers and Johnston 2007). QR/ECR leaves this decision to the supplier which can find synergies in production and distribution and in that way reduce costs.

On the other hand QR/ECR is criticized as well. All criticism is focused on that it requires a close collaboration between the parties in the supply chain and conflicts can arise when trying to find a joint strategy when each company has its own agenda (Whiteoak 1999). The costs and integration makes it hard for the customer to change supplier unlike EOQ which is only based on the company’s own costs (Zinn and Charnes 2005).

Given the situation in the food industry with its special conditions, the best option is to try adopting ECR when it is possible (Kurt Salmon Associates Inc. 1993). The retailers/wholesalers should benefit of lower ordering costs and probably lower prices due to lower costs for the supplier. The supplier will in turn be able to reduce their wastage and utilize their production units more efficient. This will of course only concern those products that are bought directly from the producer and the most suitable products are the ones with well established brands where long term collaborations will not be an issue. Costs could also be cut if all the big players on the market together decided a standard for EDI and other tools to simplify for all actors and minimize the lock-in effect (Kotzab and Teller 2003).

The results of implementing ECR has been good in general: one survey amongst American food manufacturers showed that an average company using ECR-methods achieved 30 % inventory reduction while at the same time reduced the number of stock outs by 55 % (Vergin and Barr 1999). ECR also seems to work in different cultures: when ECR-methods were first introduced in Taiwan (1998/99) the conditions were totally different than in America. Even though there exists a difference, the grocery retail chain “Wellcome” managed to reduce inventory by 33 % over a year (after nine months the figure was 46 % but a cancelled promotion and a product launch lowered the figures for the last quarter) and the service level rose from 92 % to 98 % (Tyan and Wee 2003).
When the order should be placed is quite alike regardless of which method the company is using. The simplest way is to have a level of inventory which will trigger (automatically or manually) a new order, a so called re-order level (ROL) (Slack, Chambers and Johnston 2007). This level is set so that the inventory that is left will cover the demand during the lead time plus the safety stock level. Having a ROL works just fine as long as the safety stock can handle the insecurities in supply and demand without neither stock out nor wastage. However, many companies will instead work with continuously updated material plans that re-calculate forecasts and consider actual sales and trigger an order when the material plan signals that the inventory level minus safety stock equals the forecasted demand during the lead time. This gives us a re-order point (ROP) (Slack, Chambers and Johnston 2007). The ROL and ROP occur at the exact same time in the case where the demand is constant over time (see figure 3).

![Figure 3 - an illustration describing ROL and ROP. A ROL system triggers an order when four pieces are left no matter how the incline of the demand curve is shaped. A ROP system triggers an order t time units before the safety stock level is reached.](image)

A third option is to have a fixed interval between the orders and then order a quantity large enough to fill the inventory up to an order-up-to-level (Silver, Pyke and Peterson 1998). This option is far from optimal when the goods have a last sales date to consider.

### 2.5 The bullwhip effect

The foundation of SCM is communication - both with internal parts of the supply chain and with external suppliers/customers. Communication within the supply chain is meant to share information of the current situation and expectations for the future. A distortion in this information flow will cause a phenomenon called “The bullwhip effect”. The phenomenon is expressed through amplified volatility in orders the higher upstream in the supply chain you get even though the demand from the end customers is relatively stable (Lee, Padmanabhan and Whang 2004). An example is illustrated in figure 4.
This has been very obvious in apparel and food industry where a multitude of example studies has shown that it does not matter if the consumer has a stable demand – the fluctuations in orders has increased higher upstream in the value chain (Chopra and Meindl 2001). Lee, Padmanabhan and Whang (2004) have identified four main causes of the bullwhip effect. These causes are most severe when combined.

1. **Past demand is used for forecasting** – every tier of suppliers are letting recent orders weigh high in their forecasting update. A single order that is higher than usual from a company will then generate an increased forecast for the first tier supplier, which will increase the safety stock level and therefore trigger an even higher order volume to the second tier supplier. The second tier supplier will then react the same way as the first tier supplier, which will generate an even higher order to the third tier supplier and so on. The next time the company places an order, the order volume will be back to regular, or even a little lower. This will by the same premises lead to a drop in the safety stock level at the first tier supplier, which will lower the order volume even more and trigger the opposite effect upstream.

2. **The rationing game** – when there are periods of limited supply or poor delivery performance from the supplier, a company wants to increase its own safety stock and will therefore order higher volumes than motivated. This will provoke the same behavior as in 1.
3. **Batching orders due to high order cost** – if the buying company does have a high order cost this will give the company incentives to purchase larger batches more seldom and irregular due to economics of scale. This will also cause the same behavior as in 1.

4. **Variations in purchase price** – variations in purchase price due to internal or external factors are not unusual. Raw materials are for example often dependent on how the commodities exchanges develop. A smart purchaser will buy more when the price is low and less when the price is high. This will of course also affect the behavior in the same direction as 1.

As one can see, all the above actions are rational from both parties. The company in focus will of course try to lower costs and secure delivery performance. At the same time, the suppliers will do the same as a response to their customers new order volumes and this is what generates the amplification. If there was perfect communication between the companies in the supply chain, temporary higher order volumes will not trigger this phenomenon (Lee, Padmanabhan and Whang 2004). This shows that optimizing the whole supply chain is much more beneficial than if each company sub-optimizing without communicating with the other companies. See appendix A for an example of a supply chain undergoing a bullwhip effect.

Counter-actions to prevent the bullwhip phenomena are, besides a chain of communication, e.g. implementing EDI system between retailers and suppliers (fast communication and reduction of order costs), lead time reduction (to stabilize faster and reduce need of safety stock), access to sales data (information sharing of consumer demand), regular deliveries (to increase predictability) and capacity reservation by the supplier (to avoid “the rationing game”) (Lee, Padmanabhan and Whang 2004). Olhager (2000) chooses to point out four ways to prevent the bullwhip effect: short lead times (to stabilize faster and reduce need of safety stock), dependable lead times (to reduce need of safety stock), fast information (to stabilize faster or prevent the phenomenon) and correct information (to prevent the phenomenon).

Because of that the food industry has been more visible exposed for the bullwhip effect than most other industries (Chopra and Meindl 2001) it has been a front-runner in solving many of these issues. The solution has been to develop and adopt techniques as previous discussed ECR (see 2.4.2). ECR acts as a solution to all of the problems mentioned in the paragraph above and decreases the risk of the bullwhip effect to appear (Disney and Towill 2003), but it is important to have in mind that ECR requires a close relationship between the links in the supply chain and therefore is complex to implement with all parties satisfied. An option for a full scaled ECR implementation is to apply only parts of the techniques or working with other ways of communication.
3 Methodology

This chapter will explain what methodology and methods that have been used during the study. Validity and reliability is also discussed at this stage to give the reader as much information as needed before reading the rest of the report.

3.1 Research paradigm and strategy

Collis and Hussey (2009) state that there exist two types of research paradigms that all research is based on; an interpretivistic paradigm and a positivistic paradigm. The research problem on hand requires a mainly interpretivistic approach with high involvement from the researcher. Due to the complexity of the problem it will be impossible to analyze data and come up with actions without adding own bias to the process. Eisenhardt and Graebner (2007) state that it is possible to create theories from a single-case study and that the theories afterwards could be tested on other companies.

A completely positivistic approach will not even be possible in many ways since it is impossible to fulfill the prerequisites of experimental research. Two companies with the exact same conditions could not be found; neither can the same company undergo multiple actions with equal conditions at all times.

The chosen research methodology is to conduct a case study with elements of action research included. A case study is relevant when the research should answer questions including for example “how” and “why”, investigate contemporary events and be carried out in a natural environment (Yin 2009). Action research is used when the objective of the research is to solve a problem for a client, with the client being involved during the process (Collis and Hussey 2009).

Although the research is conducted under a mainly interpretivistic paradigm, both quantitative and qualitative methods will be used to collect information. Whereas qualitative methods give an in-depth view to generate a general understanding, the information produced is biased and often needs to be complemented with objective, strictly statistical, impersonal quantitative data (Collis and Hussey 2009). Through the usage of both methods, a more complete image of the situation will be displayed.

When possible, triangulation will be used between the different data gathering methods. The definition of triangulation is: “Triangulation is the use of multiple sources of data, different research methods and/or more than one researcher to investigate the same phenomenon in a study” (Collis and Hussey 2009, p.85). This will be used to illustrate where the data supports each other and strengthen the case. Even the times when it is found that the data does not support each other will be useful and make a point in the study because that clearly indicates that something is wrong or perceived in another way than the numbers show.
The strategy for obtaining the purpose of the thesis is to work thoroughly and consequently during the whole process. Aronsson, Ekdahl and Oskarsson (2003) present a work method for running projects within the field of logistics which has been a guideline throughout the case study. A slightly modified version of their model is illustrated in figure 5 and described below:

1. **Clarification of conditions** – there are multiple conditions that are important to be aware of already from the beginning. Conditions concerning time frames, resources, what parts of the organizations that will be affected etc (Aronsson, Ekdahl and Oskarsson 2003). These conditions have been developed based on requirements from KTH and Arla Foods CSE – they are mainly described in chapter 1 of this report.

2. **Description and analysis of current situation** – to really understand what the problem is and what possibilities and restraints that exist, it is crucial to make a thorough analysis of the current situation. This was done in the first part of the empirical study and can be found in sections 4.2-5.2.

3. **Development of alternative solutions** – when the problem(s) is isolated, the next step is to develop alternative solutions. Step 2 and 3 are often carried out with an iterative work method (Aronsson, Ekdahl and Oskarsson 2003). This step is portrayed further in chapter 6.

4. **Comparison between current situation and alternative solutions** – this step often considers financial aspects of what the gain will be compared to implementation costs/risks. This has not been a separate step in this research but it is included in step 3 and hence presented in chapter 6 as well.

5. **Choice of solution** – the choice is based on both financial figures and other “soft” values. This report provides merely a recommendation for what actions to take and these are listed in section 6.4.
6. Implementation of changes – this step is not in scope of this report.

7. Follow-up – this step is not in scope of this report.

### 3.2 Data gathering

The qualitative data stands for most of the empirical material, but it is collected through several methods. Yin refers to “The six sources of evidence” (Yin 2009, p.101) as different methods of collecting data when performing a case study. The six sources he brings up are documentation, archival records, interviews, direct observations, participant-observations and physical artifacts. To increase the accuracy of the data several of these information sources have been used. The two most significant methods have been interviews and observations. These two methods have been chosen instead of e.g. surveys because the complexity of the problem has required follow-up questions/discussions. Furthermore all respondents have not answered the same questions, which would have made the survey hard to design. The quantitative contribution to the data gathering is mostly data base extractions. The extractions have either been used as foundation to analyze specific questions or as a statistical material produced to generate examples used as a discussion base.

#### 3.2.1 Interviews

Interviews are seen as perhaps the most important data source of all in a case study (Yin 2009). Saunders, Lewis and Thornhill (2007) states that there are three types of interviews and describe them as follows:

- **Structured interview** – the respondent are being asked pre-determined questions in a specific order. The answers are noted and no new questions added during the interview.

- **Semi-structured interview** – the interviewer has a pre-determined line of enquiry and most often prepared questions but can vary the questions asked or add new ones depending on how the respondent is answering.

- **Unstructured interview** – the interviewer just have a theme and let the interview develop whichever way that is suitable at the time.

The main part of this case study is not suitable for having structured interviews because of that the phenomenon under study is too complex. A structured interview requires the interviewer to have a deep knowledge of the studied phenomenon or else the respondent will be locked in with no possibilities to elaborate in another direction than what the interviewer already believes. An unstructured interview will however be a little too loose and it is a risk that the original focus of the interview will be lost while going in on side-tracks. Therefore this case study contains almost only semi-structured interviews with the intention of getting specific questions answered while still leaving room for flexibility if anything comes up during the progress of the interview. To avoid the risk of losing interesting side-tracks, the
possibility of a follow-up interview always exists. The interviews were meant to explore “data on understandings, opinions, what people remember doing, attitudes, feelings and the like” (Arksey and Knight 1999, p.2).

However, a few interviews were hold in a structured way. The concerned interviews have been conducted with planners responsible for the worst performing items (in wastage aspects). The planners have answered pre-defined questions about why the items in question have performed poor. The respondents were allowed to answer in the way they wanted with the intent to avoid pushing them into a researcher bias by pre-defined answering options. Instead their answers afterwards were categorized and statistically analyzed.

**Selection of interview respondents**

To obtain a great understanding of the issue and at the same time secure the validity of the report, the interview respondents have been chosen carefully. Interviews have been held with employees at different levels and in different roles at Arla Foods CSE, which is one method to decrease the risk of bias (Eisenhardt and Graebner 2007). All interviews except a couple have been face-to-face. The enquiries have circled around current processes, thoughts about factors and actions, historical attempts and perceived problems.

In total 19 respondents have been interviewed. The respondents have either been interviewed to contribute to the general knowledge of the phenomenon under study or because of that they possess knowledge or experience on a specific matter of interest. Everyone at the department of Forecasting & Planning working with Special Products, have been interviewed with the intent to absorb all opinions and thoughts independent of experience, assortment or history. The project managers and planning managers have been interviewed due to their current and historical work with wastage reduction as well as their vast experience of a leadership perspective. The system specialist is expert on technical possibilities and errors. The head of Forecasting & Planning and the Vice President of the Supply Chain brings a management perspective to the study. Employees at other departments have also been interviewed when questions regarding their area of expertise have been raised. No Milk planners has been interviewed since they are not a part of this thesis’ focus and work under different conditions as well as using different methods than the planners from the Special Products team.

Below follows a list of the roles that have been interviewed during this case study. Each role has a description of what their responsibilities related to this thesis are.

**Head of Forecasting & Planning (F&P) (Dan Jardal) –** has the responsibility that F&P lives up to the wastage cost KPI with respect to the balance of all KPIs. All decisions must go through him, so he is a primary stakeholder in the study. He is also responsible for all employees at F&P and has the knowledge of capabilities and prioritization.
Project Manager F&P (3 persons) – all three project managers at F&P has a significant knowledge and experience of wastage. All of them have been employed a long time and have not only knowledge of the current status, but also on what has been done historically and how the outcome has been.

System Specialist F&P – the system specialist is the one that knows the most of the IT-systems. This is important in both the aspect of how the IT-systems affect the wastage as well as possibilities and constraints exist to utilize the IT-system for actions to reduce the same.

Planning/forecasting manager F&P – the planning/forecasting managers are responsible for each team (Special Products, Milk and Forecasting) and have the same responsibilities as the head of F&P, but for their own team. They have a more detailed knowledge and especially the planning manager for Special Products is a major stakeholder.

Planner F&P (4 persons in-depth and 4 persons briefly) – the planners are the employees that works with the processes on a daily basis and therefore has the most detailed knowledge at all. It is also of great interest to compare their work procedures and prioritizations with the outspoken policy from their superiors. The planners are also major stakeholders since they are the one that will be ultimately affected by all changes.

Vice President of Supply Chain – the VP of Supply Chain is a member of the top management team at Arla Foods CSE and reports directly to the CEO. He is the one ultimately responsible for all costs that comes from wastage and his input is therefore of great interest.

Other roles of interest – Project Manager Customer Service (2 persons), Transportation Manager, Inhouse Sales Manager, Controller, Forecaster (2 persons).

3.2.2 Observations
As previously pointed out, there are two types of observations; direct observations (sometimes called non-participant observations) and participant observations. The difference between them is the researcher’s role as an observer. Direct observation means that the researcher passively observes the actions of the research subjects (Collis and Hussey 2009). Participant observation focuses more on understanding and the observer interacts with the subject to gain insight of motives and practices of those being observed (Collis and Hussey 2009).

Observations have been made in two steps to increase the validity of the research. At first direct observations of the work process were made to create an understanding on how the employees worked with wastage related issues – both proactive and reactive actions were of interest. When this information was collected, participant observations were made to understand why some actions were done and some neglected. An important step of these observations was to question the actions of the employees to create a reaction that could lead to a deeper understanding.
3.2.3 Quantitative data gathering
As mentioned earlier, there has been a need to collect quantitative data as well even though this is a mainly interpretivist case study. The quantitative data has been gathered to complement the qualitative data in the analysis of what causes wastage. The data consists of extractions from the Arla Foods CSE’s internal database of inventory transactions and delivery performance (secondary data).

The database extractions consist of all inventory transactions made due to wastage at all FVCs in Sweden and all orders/deliveries from all FVCs in Sweden. The data has then been sliced in several ways with the intent to isolate transactions based on FVC, product, planner, time etc. to find connections and causes.

3.2.4 Other methods used
Process charts and other documents were analyzed to secure the formal, written, standpoint of Arla Foods CSE. The documents originated from the internal data base and in those cases where it was hard to know if the document was valid they were confirmed by the responsible managers.

Focus groups were used during the study since it was important to utilize the competence that already existed within Arla Foods CSE. The focus groups that were summoned consisted of a few persons with key competences and experiences. The groups did both help with feedback on ideas and thoughts developed during the research as well as they had the chance to discuss own suggestions.

3.3 Reliability, validity and generalization
One general definition of reliability is “Reliability refers to the absence of differences in the results if the research were repeated” (Collis and Hussey 2009, p.64). The nature of the case study is that it is hard to reproduce the study, since it is conducted in a natural setting with very specific circumstances that probably will not be able to repeat again. Yin (2009) has therefore complemented this definition with a case study specific definition where he stresses that the same study could hypothetically be done by someone else and still come to the same conclusion. This study is reliable in the way that all information is cross-checked when possible by using triangulation and the methods used are described in the report. However, a case study could never be completely reliable because of the fact that it is impossible to document all small enquiries and discussions with employees.

Validity is “The extent to which the research findings accurately reflect the phenomena under study” (Collis and Hussey 2009, p.65). This specific study has been thorough and covered a larger area than the actual research question. Clarifications have been made to make sure that all persons involved in the study have answered on what is requested and key persons have had the chance to take part of the results and give their opinions during the study. All this have been done with the intent to generate as high face validity and construct validity as possible.
As stated already in the beginning of this report, the aim is to make this research applicable to companies in the same situation as Arla Foods CSE with high inventory turnover and short shelf life. Many of the conclusions are probably transferable to those companies but the reader must bear in mind that this study is conducted on one company with the circumstances and set-ups existing at the time. This reduces the generalizability, but my opinion is that it is still relatively high since the study focuses more on general processes and not in details. This opinion is supported by Eisenhardt and Graebner (2007) which conclude that it is possible to draw conclusions and create theory based on one, well-performed, case study.

3.4 Source criticism

The theoretical frame of reference consists of a combination of research articles and academic books. The aim has always been to use multiple sources to support statements and the general direction of the theory, but some information has been a unique contribution from individual articles. This should however not be an issue since all articles have been qualified for publication in scientific journals.

When it comes to the empirical data gathering most of the data has come from interviews with employees. Interviews are never unbiased and it is possible that the respondent’s personal opinions only reflect their experience and not the actual situation. The respondent’s experience is probably influenced on specific events that have occurred or by their knowledge and way of seeing things. There could also be a political agenda behind the statements of the respondents - what is emphasized and what is concealed could be a result of personal agendas. The bias itself is however not irrelevant, because the problem that is experienced could cause more damage than the actual problem. The bias should have been reduced by using several respondents in similar position and hence a correct image is given.

The finished report has been read by two managers at Arla Foods CSE to verify that data and statements are correct.
4 Arla Foods – the case company

This chapter gives a description of the case company Arla Foods and a snapshot of their current situation when it comes to levels and trends of wastage costs.

4.1 An introduction to Arla Foods

Arla Foods is the result of a merger between the Swedish dairy cooperative Arla and the Danish dairy cooperative MK Foods in April 2000. The origin of Arla Foods could be traced back to late 19th century when the first dairy cooperatives were founded in Sweden and Denmark (Arla Foods 2012a). The merger did not affect the ownership, Arla Foods is still a farmers’ cooperative and is owned by 8 024 farmers in Sweden, Denmark and Germany7 (Arla Foods 2011). Arla Foods has 17 417 employees world-wide and products are sold in more than 100 countries (Arla Foods 2011). In 2010 the net turnover was 49 billion DKK and that made Arla Foods the 8th largest dairy company in the world (Voorbergen 2011). The turnover increased by 12 % during 2011 to a record high 55 billion DKK (Arla Foods 2012b), so Arla Foods is growing rapidly.

Arla Foods organization has decentralized most of the functions to regional divisions. One of these divisions is Arla Foods CSE (which includes markets Sweden and Finland) and one of these functions is supply chain management and the underlying area of Forecasting & Planning. The department of Forecasting & Planning is divided into three separate teams with individual planning/forecasting managers: Forecasting, Milk and Special Products. In addition to these business units, the department includes three project managers, one system specialist and a senior manager that is in charge of the whole department of 29 employees in total. Figure 6 illustrates the organization of Planning & Forecasting.

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7 600 German farmers were included in the 2011 merger with Hansa-Milch Mecklenburg-Holstein eG.
Reduction of wastage costs for products with short shelf life
Viktor Leek (2012), KTH

Figure 6 - organization chart of Planning & Forecasting department (Arla Foods 2012d).

Forecasting & planning’s task is to coordinate the supply chain and be the link between customers and suppliers. Upstream suppliers, manufacturers and distributors need to have the best possible conditions to deliver the exact amount, at the requested time to meet the demand from wholesalers, retailers and end customers. Figure 7 gives a simplified view of how the value chain is constructed. Remember that this report is focused on the third step, which is indicated by the red circle.

Figure 7 - a simplification of the value chain. Arla Foods are controlling the first three steps of the value chain. This thesis is focused on the last one of those three when the goods are finished.

All of the work that the department does is supposed to contribute to the achievement of three stipulated KPIs:

- Delivery performance.
- Forecasting precision.
- Wastage costs.

The main challenge is to increase delivery performance without giving a negative spill-over effect to wastage costs and the other way around. These two KPIs could easily undergo a quick-fix at the expense of each other, but that would just keep the company at status quo.
4.1.1 Arla Foods environmental policy
Arla Foods wants to be an environmental friendly company and works hard to create that image internally and externally. This work has lead to an environmental policy under the slogan *Closer to Nature* (Arla Foods 2012a). This policy is meant to show that Arla Foods is taking responsibility for the environmental impact throughout the whole chain via ecological farms, efficient production, transport optimization etc (Arla Foods 2012c). Alongside the strategy of minimizing their own environmental impact, they also want to educate consumers and are having relationships with, e.g. schools (Arla Foods 2012a). As a part of *Closer to Nature*, there is in Arla Foods’ interest to avoid wastage. It is outspoken and communicated that Arla Foods has a vision of zero wastage and works towards this. This means that having large proportions of wastage is not only bad for the financial result, but it is also bad for their brand promise and their image as a company that is *Closer to Nature*.

4.2 Current wastage situation at Arla Foods CSE
As mentioned earlier, Arla Foods CSE is currently struggling with wastage costs increasing from a level already above Arla Foods CSE’s target level (figure 8). Wastage costs are especially high around holidays and in periods directly after product launches (figure 9). Holidays are hard to plan for two reasons: the business week is much shorter and the demand is extremely high which makes miscalculations in the forecast extra hurtful (Modin Arla Foods 2012). Product launches are hard to plan for since the new product does not have any history to base the forecasts on (Modin Arla Foods 2012). The forecasters and commercial side then go for a higher demand interval hence the cost of a stock out in the middle of a successful launch would be higher than the wastage cost for an equal amount of extra goods (Larsson Arla Foods 2012). In these two cases Arla Foods is working with anticipation inventory in addition to their usual safety stock. Arla Foods is also a producer of private label articles, which are customer specific brands. The problems of those articles are the same as for Arla Foods’ own articles, but the private label articles are much harder to manage because of the dependency on only one customer (consisting of several individual stores of course) (Modin Arla Foods 2012).
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Figure 8 - the wastage costs are increasing rapidly. First half of 2010 was in line with the target level, but since then has the difference between target and result kept increasing. Data extract from Lusa.

Figure 9 - 2011’s wastage costs. The peaks are almost always related to product launches or holidays. Data extract from Lusa.
Wastage costs on an article level could be divided into two different types of wastage (illustrated in figure 10) (ProjectManager-II Arla Foods 2012). The first type of wastage is the wastage that occurs on single occasions (or over a shorter period of time) due to a specific reason under conditions that only occurs once (or at least very seldom). These costs could be related to earlier mentioned holidays and product launches, but they could also be the result of a bad campaign, one bad forecast, system error etc. It is often a miscalculated anticipation inventory that lies behind the wastage costs. The second type of wastage is the wastage that is on a consistent level all the time, higher than the target level but yet much lower than the top levels that the first type of wastage reaches. One reason could be a too high safety stock, but it could also be anything else connected to the article set-up. To successfully reach the target level it is of equal importance to work with both types of wastage costs and find ways to prevent them from happening or to counter them when already occurred.

The distribution of wastage costs between Milk and Special Products is not reflecting the distribution of sales. Special Products has a significant higher share of total wastage costs than it has of total sales. This is due to two reasons. First of all the prices per kg of the Milk products are significantly lower than for Special Products. As you can see in figure 11 there is still a difference even if you use weight instead of cost as unit. The other half of the truth is that Milk products are of a more traditional nature with a predictable demand level and hence are easier to plan.
4.2.1 Heavily discounted sales instead of wastage

Heavily discounted sale (HDS) is an effort of damage control when the last sales date of the goods has expired. Since the products’ expiration date has not been exceeded they can still be consumed, so the customers are still interested in purchasing the goods as long as the price is low enough (Nilsson Arla Foods 2012). To flag a batch for HDS, the personnel at the FVC tags the batch with a specific code that makes it appear on a list monitored by inhouse sales department, which then tries to make a deal (Nilsson Arla Foods 2012). There are a few general rules concerning both which articles could be available for HDS and how the deal with the customer should be designed (Pedersen Arla Foods 2012). To be available for HDS a batch must have at least seven days before expiration when the customer receives it and there are rules on minimum quantities and value to motivate the handling costs connected to HDS (Pedersen Arla Foods 2012). The agreements with the customer are controlled by a maximum discount level and the discount must be transferred directly over to the consumers’ purchase price (Pedersen Arla Foods 2012).

The major benefit for Arla Foods is obviously that the goods are saved from wastage and this is not only financially beneficial, it would also follow their *Closer to Nature* vision of zero wastage. It would also give customers that usually are price sensitive the opportunity to purchase Arla Foods’ products discounted and hopefully continue purchasing the product at full prices afterwards. The downside is that the time and resources spent on HDS could have generated more revenue if it had been focused on other tasks. Too large quantities sold discounted could also affect full price sales as well as damage Arla Foods’ brand and pricing strategy (ProjectManager-I Arla Foods 2012).
4.3 Information about LUSA

LUSA is a data base specifically developed for Arla Foods set up to transform raw data into designed reports in a simple way. LUSA consists of two sub-data bases; one data base focusing on delivery performance to customer and one data base focusing on internal inventory transactions. The data base for inventory transactions is most relevant for this thesis since it includes wastage and it gives the users multiple options to design the report as they want. The variables that exist are:

- **Measuring unit** - the users can choose one or multiple ways to present wastage from six different measuring units: cost price, number of items (consumer), number of items (sales batch), number of tons wastage, number of tons sold and wastage in percentage of sales.

- **Time period** – the users can chose a time period in days, weeks, months or years. The data can be presented in either a total or split into days, weeks or months. The choice depends on if one wants to see a trend or just the total figure.

- **Inventory unit** – the users can filter if they want to have data from all FVCs or a specific selection. The data can be presented as a total or separated on each FVC.

- **Transaction code** – the users can filter on which transaction codes to show and if the data should be presented on each transaction code or not. This thesis is only interested in transaction codes that indicate wastage.

- **Articles** – the users can choose what articles that should be included in the report. The articles are grouped at six different levels depending on if one is interested in specific articles or just a type of articles. The data can be presented as a total or at any of the six different levels.
5 Results – empirical data

This chapter acts as a presentation of the research findings regarding which factors acting as wastage drivers at the case company. The presentation is structured in categories to make the findings easier to analyze.

5.1 Processing of statistical data

The quantitative data gathering in this thesis is based on data from Arla Foods CSE’s database LUSA. Different extractions have been combined, processed and analyzed with the result of multiple reports. These reports will be one piece to find the root causes of Arla Foods CSE’s wastage. The reports are presented in detail below.

5.1.1 Wastage reasons stated for top ten articles weekly in Q3-Q4 2011

The weekly reports on the wastage situation are based on data from LUSA with the heaviest aspect aimed at the financial perspective with cost price as the main measuring unit. The report always includes top ten articles with the highest wastage costs during the week. The project manager responsible for the wastage reporting has made it a routine to request comments on what reasons lay behind the high wastage cost from each article’s responsible planner (ProjectManager-II Arla Foods 2012). A method of categorization of the stated reasons for Q3-Q4 were used to group the reasons and hence get a better understanding of what drives high wastage costs.

The comments from the planners are written in free text without any directions, so the categorization is based on subjective interpretations and decisions. Some of the categories were pre-defined, but most of them were defined and created during the data gathering process when similar reasons showed up multiple times. Each comment was reviewed several times as the categorization changed and developed until all categories were settled. The goal of the categorization was to create categories that were detailed enough to delimit a specific problem area but general enough to include a number of cases. The wastage reports, and hence the comments, include Arla Foods CSE’s complete product range, but only articles from the group Special Products have been considered in the categorization. The categories used were in alphabetical order:
The data shows three important aspects: (1) the distribution of wastage value of top ten articles between Milk products and Special Products (figure 12), (2) a number of reasons that are considered to drive wastage costs and (3) the internal distribution of value in between the stated reasons (figure 13).

The percentage number indicates how large share of the value each category has. The value is in this case the total value of Special products in the top ten list for Q3-Q4.
5.1.2 Wastage reasons stated for the 80 worst performing articles

The presented data above gives a good view on how the planners interpret the wastage reasons for articles that appear on the weekly top ten lists. Appearing on the top ten lists indicates that something unusual has happened during the week in question and the planners have only responded on what that specific issue was. This is an important input to receive, but it is equally important to find the articles that consistently have high wastage costs without reaching the top ten lists. A parallel could be made to earlier discussed differences in between different types of wastage (section 4.2). To find those articles a similar method as in the previous section were used.

Data from LUSA including all inventory transactions connected to wastage for the last six months\(^9\) were extracted with the intent to find the 80 articles that had performed worst in aspect of wastage. The article could be qualified as a bad performer from four different aspects with the intent to capture all kinds of problematic articles. These were the qualifiers:

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\(^9\) August 2011 to January 2012
A wastage rate of more than X % of sales.
A total wastage value of more than Y SEK.
More than Z days with one or more wastage transactions on any FVC in Sweden.
More than W items (consumer) of wastage.¹⁰

Most of the articles qualified under multiple conditions.

All planners were interviewed concerning the articles on the list that they were responsible of and answered what they thought that the problem(s) was with each article. They had the opportunity to answer in their own words and to utilize all systems, documentation and tools to give an answer as accurate as possible. Their answers were then categorized in the same way as in 5.1.1. This resulted in six categories (illustrated in figure 14):

- Batch size¹¹ (23,33 %).
- Delivery frequency¹¹ (12,22 %).
- Forecast deviation during product launch (13,33 %).
- High volatility in demand (13,33 %).
- Repeated forecast deviations (12,22 %).
- Other (25,56 %).

Fig. 14 – Distribution of reasons behind the high wastage of the 80 articles with worst performance from a wastage aspect. The reasons are categorized based on interview answers.

¹⁰ This was the qualifier of lowest significance.
¹¹ Batch size and delivery frequency were displayed as one category in the previous categorization because it was impossible to separate them from the reports. This categorization is done via interviews, which made it possible to be more detailed.
¹² The percentage number indicates on how many of the 80 articles in the selection that the reason was brought up as a cause of wastage.
5.1.3 Wastage and shortage at the same time

Arla Foods CSE’s strategy of having multiple FVCs adds another dimension to the forecasting. The forecasting team already has a big challenge to estimate the total demand for an article and then an additional challenge to estimate the demand for each FVC’s regional market (Modin Arla Foods 2012) (Wahlström Arla Foods 2012). The total demand is easier to forecast than the regional demand since regional deviations often tend to compensate each other. The regional demand for the combination of some FVCs and articles is highly dependent on a few large customers. If there are deviations at those customers’ orders the effects on the whole FVC-article combination could be severe.

To understand the size of the problem and clarify the solution potential, a basic data analysis of the phenomenon of wastage at one FVC and shortage at another at the same time has been conducted. Wastage transaction data from LUSA has been cross-referenced with delivery performance data from another database to find out the frequency rate of the phenomenon. The data extraction covers two months and the sought result is to find occasions when an article has been trashed at any FVC while another FVC at the same time is having shortage the same day [W], had shortage the day before [W-1] and/or had shortage the day before that [W-2]. The results are summarized in the table below:

<table>
<thead>
<tr>
<th>Situation</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastage related inventory transactions</td>
<td>4 033</td>
</tr>
<tr>
<td>Wastage at one FVC while having shortage at another FVC in one or more of the days W, W-1 or W-2</td>
<td>2 054</td>
</tr>
<tr>
<td>Wastage at one FVC while having shortage at another FVC in two or more of the days W, W-1 or W-2</td>
<td>952</td>
</tr>
<tr>
<td>Wastage at one FVC while having shortage at another FVC in all three days W, W-1 or W-2</td>
<td>326</td>
</tr>
</tbody>
</table>

Table 1 – this table shows how frequently goods are being trashed at one FVC while at the same time another FVC has suffered of shortage the days before wastage. Data extract from Lusa.

Bear in mind that this is a summary of all hits received where the delivery performance is below 100 % and the wastage cost is over 0 SEK. The same table with requirements of a delivery performance below 99 % and a wastage cost over 1 000 SEK gives the following results.

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13 November and December 2011
Table 2 - this table has excluded small shortages or/and wastages. The percentage number illustrates the decrease from the original numbers in table 1. Data extract from Lusa.

This generates a significant decrease in all numbers, but it is still a number high enough to work with. The most important row in the table is the last one where it is obvious that there is a problem with shortages and where the transportation time for the excessive products from one FVC to another still makes them relevant.

### 5.2 Areas of interest

Interviews, observations, discussions and other qualitative data sources have complemented the quantitative data and together contributed with several interesting angles to investigate further. This section will display and group the most important contributions to solve the research problem. The grouping is based on what problem the data could be sorted under.

The focus during the data gathering has been to identify problems that cause wastage. The reader must bear in mind that most of the presented data is unprocessed, probably biased and merely a description on how the situation is perceived. The quantitative data presented earlier provides some help to increase the reliability. The data has also been a source of inspiration that has been used during the qualitative data gathering.

#### 5.2.1 Article set-up

Each article has its own set-up which is a multitude of parameters important for planning. The parameters that are considered for each article are days before expiration, sales days to customer, batch sizes, production frequency, ordering multiples, safety stock, forecast, day distribution etc. All parameters are possible to change except from the number of days before the article expires (this is controlled by legislations and health reasons) and the article should be set-up in the way that is most beneficial for Arla Foods (Jardal Arla Foods 2012). Some of the parameters are ultimately controlled by other stakeholders; e.g. production facilities and the commercial side of the business.

However, the planners experience that some articles are impossible to plan from a wastage perspective due to their set-up (Planner-II Arla Foods 2012) (Planner-I Arla Foods 2012) (Planner-III Arla Foods 2012). The explanation they give is that the production facilities are optimizing their own result by producing larger batches more seldom and that the forecasting department is struggling with some articles which cause major wastage on a regular basis. This could create trouble in two different dimensions: first of all the batch size could be larger than the demand is for the period which always will generate wastage (Planner-III Arla Foods...
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2012). The other dimension is that long intervals between deliveries require long lead times which makes the forecasting more insecure and the risk of either wastage or shortage much higher than usual (Planner-II Arla Foods 2012).

The same image is also shared on management level (ProjectManager-I Arla Foods 2012) (Jardal Arla Foods 2012) (ProjectManager-II Arla Foods 2012) (Carlsson Arla Foods 2012), with the addition that they are worried that the planners are not prioritizing the maintenance of the parameters (Jardal Arla Foods 2012) (ProjectManager-II Arla Foods 2012) (Arvidsson Arla Foods 2012). The planners have the responsibility to keep the article set-up up to date and this means that they have the mandate to change the parameters whenever they want (Jardal Arla Foods 2012). One of the planners admits that the maintenance of the parameters is a little neglected and that the wastage costs could be lowered if it was done more thoroughly, but this is only because of that the general workload does not leave enough time to prioritize maintenance (Planner-I Arla Foods 2012).

The department’s system specialist took part in a project that developed a model for analysis of the effects of set-up to be used before deciding changes in batch size and/or production frequency, but this model is not in use anymore (Carlsson Arla Foods 2012). Instead the focus has shifted to lowering production costs during the last couple of years, without any major discussions on how this will affect the wastage at the FVCs (Planner-II Arla Foods 2012).

The consensus of all parties regardless of hierarchical level is that the vast majority of the wastage costs relates to a little minority of the articles and most of those articles have a current set-up that automatically drives wastage costs (ProjectManager-III Arla Foods 2012) (Arvidsson Arla Foods 2012) (ProjectManager-I Arla Foods 2012) (Planner-II Arla Foods 2012) (Planner-III Arla Foods 2012).

5.2.2 Communication
Communication is always a crucial ingredient in the success of a company and could hence become a liability if not working properly. The previous section (5.2.1) shows tendencies of poor communication. The article set-up is now written in stone and if the set-up is not optimized for Arla Foods CSE, then the set-up should be changed and the problem vanished. In this case all departments seem to work on their own, trying to optimize their own GHSDUWPHQW\textsuperscript{7}VUHVXOW7KLVVXE optimization may benefit the department in question, but not Arla Foods CSE. So why does this sub-optimization still continue? One part of the answer is the title of this section – communication, or rather the lack of communication.

As you have learnt from section 5.1.1 all planners are supposed to report what caused the wastage when an article is on the weekly top ten list. This reason is found and reported to the project manager responsible for the wastage reporting. However, the causing department does not receive the same information and could hence not change anything in their behavior. The report produced by the project manager is only for internal use (ProjectManager-II Arla Foods 2012) and the planners seldom take action passing the information forward. The project
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manager also recognizes the fact that even though the cause is established, this does not equal that an action is taken to diminish the problem. Multiple planners admit to this in interviews or fail to do this during observations (Planner-IV Arla Foods 2012) (Planner-II Arla Foods 2012) (Planner-I Arla Foods 2012). Answering on the question why the information does not leave the department the answers are varying. Reasons that have come up during interviews are:

- Insecurity of whom the recipient should be and that it should be done (Planner-III Arla Foods 2012).
- The feeling that the recipient does not care and insecurity of what the next step is (Planner-II Arla Foods 2012).
- Prioritization (Planner-I Arla Foods 2012).

The forecasting manager serves as both a witness and a participant in this question. His forecasters do not always get information about poor forecasting, but when they get the information they are in turn not passing it on to e.g. the commercial organization that has misjudged a product launch (Modin Arla Foods 2012). Per Arvidsson (2012), planning manager for Special Products, says that the routine from the planners should always be to pass the information forward to the concerned department to generate some sort of action at that department. If this action is not successful they should take the discussion with the responsible product manager that should be unbiased from sub-optimization and only look after Arla Foods CSE’s interests (Arvidsson Arla Foods 2012). However, this routine is not yet established among the planners, the communication channels are not specified and the organization is not prepared at the moment (Arvidsson Arla Foods 2012) (Jardal Arla Foods 2012).

5.2.3 System

The computer system could also be a cause of some of the wastage. The ERP-system Movex is set up to generate a warning when a quantity on stock has a last sales date that will be exceeded before the article will be sold according to the current forecast. This appears in the material plan as a transaction coded 960 (a so called “960 transaction”) and is meant to alarm the planners about the problem and give them time to solve it before the product ends up as wastage (Carlsson Arla Foods 2012). However, the system specialist Marcus Carlsson (2012) explains that there is a “defect” in the system that sometimes prevents the warning from appearing. The defect is caused by the forecast not being compared to the actual sales on a daily basis but instead being calculated over the whole time bucket just before the next planned delivery (Carlsson Arla Foods 2012). This defect is only affecting goods with longer intervals between deliveries and especially those with long ordering lead times as well (Planner-I Arla Foods 2012). The planners have also identified the defect and find it frustrating that they receive the warnings too late and not have the time to act upon it (Planner-I Arla Foods 2012). The system will in most cases only sense the redundancy after a
time bucket is closed and book the remaining quantity as a 960 transaction if the volume is too large to be sold off before the last sales date expires. If the system acted on a daily basis, the planner could react directly and both handle the excessive goods as well as avoid the situation to spin out of control.

Another system related problem that has been brought up by more than one planner is the sometimes failing communication between the ERP system Movex and the warehouse system Astro (Planner-I Arla Foods 2012) (Planner-V Arla Foods 2012). Both systems should, and usually do, have the same stock balance but nevertheless they sometimes display different levels. If the planners are unaware of the difference, they will base their actions on a stock level that might be wrong. Both planners that brought this up yet agree that this is not a main wastage driver (Planner-I Arla Foods 2012) (Planner-V Arla Foods 2012).

5.2.4 Customer set-up
Arla Foods CSE has a standard agreement for customers, based on general policies and terms stated by Arla Foods CSE. This agreement is valid for all purchases, whether the counter-part is aware of it or not, and a purchase order activates the agreement automatically (Wahlström Arla Foods 2012). However, some customers have negotiated a unique agreement just for them which often cause disturbances in Arla Foods CSE’s work with inventory management. The specific detail of the agreement that will be in focus here is the variation between set-ups on how many days the article should have left to be sold before expiration, when delivered to the customer. In this area we can find variations; some customers have negotiated that they always should receive the best possible date that is on stock (Wahlström Arla Foods 2012) and some customers just have stipulated more favorable levels than the standard agreement (Planner-II Arla Foods 2012). The customers that have negotiated these deals are obviously not the smallest customers but rather the largest, which gives an even greater impact to the inventory management work. The variation in agreements exists because of two reasons: (1) these differences have existed as far as anyone remembers which makes them uncomfortable to change and (2) some of the variations have the purpose to benefit the wholesalers with a better date than the retailers (Andersson Arla Foods 2012).

The main problem with these kinds of customer set-ups is that the planners and forecasters will suffer from the lack of predictability (Wahlström Arla Foods 2012) (Planner-II Arla Foods 2012). If everybody had the same agreement, the forecaster would help the planner to keep the order intake in phase with the sales. If the forecast is a hundred percent accurate, the goods flow will be impeccable with no wastage at all and no safety stock needed. A safety stock would allow smaller deviations to occur without any visible impact on either delivery performance or wastage. If instead the customers all had unique agreements when it comes to how many days they are entitled to, the forecasted quantity of sales might still be correct, but this will not matter if the customers have agreements that eliminates the FIFO (First In First Out) rule and replace it with their own negotiated dates. Even a forecast that is a hundred percent accurate will cause wastage, since the oldest articles will not be sold at the timing they need to have.
This adds a new dimension to the forecasting work, where the forecasters have to plan for these kinds of events. The forecasting procedure itself might not be that much more complex than it already is, but the reliability will take a deep toll because of that the forecast in a higher degree will be dependent on separate customers instead of the market as a whole, where changes in customers’ demand tend to balance each other up.

5.2.5 Volatile demand pattern

Both forecasters and planners describe a volatile demand pattern from the customers (Modin Arla Foods 2012) (Planner-IV Arla Foods 2012). This volatility origin from several different reasons:

- The customers are purchasing larger batches more seldom in an irregular interval when it comes to products from Arla Foods’ assortment with longer shelf life.

- Holidays are both driving general demand because both customers and consumers are filling up their stocks before the holidays starts as well as they drive specific demand of products that are consumed during the holiday (e.g. sour cream at Midsummer).

- Some products’ sales are correlated with the weather.

- Not all market activities from the customers are communicated to Arla Foods.

- Uncontrolled marketing drives demand. E.g. demand for Keso increased heavily after it had been mentioned in the television show “Biggest Loser” (Planner-II Arla Foods 2012).

The volatility increases and becomes even more unpredictable when substitute products exist (Planner-II Arla Foods 2012). This statement is supported in literature where it is stated that obsolescence due to the existence of substitutes often is underestimated (Slack, Chambers and Johnston 2007). The obsolescence risk is of course greater when the article’s shelf life is shorter, the customer’s requested lead time is shorter and the substitute is more similar. If a FVC has shortage on e.g. one specific yoghurt flavor the planning system will accumulate all customer requests without delivery and add them to the forecasted demand for the upcoming order (Planner-II Arla Foods 2012). This requires that all declined customers (due to shortage) are coming back with the exact same order when the next delivery arrives while at the same time not decreasing the volume that they would have ordered after the next delivery anyway. In reality the customers do often either (1) purchase a substitute flavor or (2) go one delivery period without providing the flavor to their customers and after that go on with business as usual since their customers are purchasing substitutes anyway. However, this is not the truth for all products, the more unique a product is and the longer shelf life it has the higher chance of the customers coming back with the same order (Planner-II Arla Foods 2012). Hence the accumulated demand must be considered.
An additional issue, related to demand volatility, which generates wastage, is the purchasing pattern and strategies of the largest customers. Some of Sweden’s largest grocery chains have applied a centralized purchasing strategy with their own distribution centers that the individual stores purchase their goods from (Planner-II Arla Foods 2012). This is of course beneficial for both supplier and customer in many ways. If the communication however fails it can both drive wastage in the short term by a single incorrect forecast, but more importantly it can start a bullwhip effect (theoretical review in section 2.5). One of the planners describes perfectly how the bullwhip phenomenon has occurred (without calling it a bullwhip effect) when one of the largest customers suddenly ordered a much larger quantity than forecasted which made the forecasting department to increase the upcoming forecasts and the planners started to order higher quantities (Planner-II Arla Foods 2012). The next order was instead much smaller than the original forecast and very much below the revised forecast, which instead made both forecasters and planners to panic and try to hit the stop button. This caused massive wastage costs and an investigation surfaced that the customer had ordered so much because of that Arla Foods CSE had struggled with delivery performance for a couple of weeks and the customer wanted to be sure that they received enough quantity to keep their business going on as usual (in theory referred to as “the rationing game”). When they received that quantity, they of course had more than they usually have on stock and did therefore order a lower quantity the next time. Arla Foods CSE was not aware of this so hence the bullwhip effect. It took a while to stabilize the inventory levels with both poor delivery performance and high wastage costs as a result of the aftermath of this problem. This is a description of one occasion, but the phenomenon occurs frequently.

5.2.6 Work process
One of the primary areas of interest prior to the empirical data gathering was the work process related to wastage – both proactive and reactive handling. Lots of questions circled around: does such a process exist? If so, how is the process designed? Does everybody follow the process? Can this be improved in one way or another? The answers on the questions varied a lot depending on the source they came from, which created an impression of a very scattered department with permanent misconceptions built in.

The answer to the first question is that a process, or actually multiple processes, aimed at preventing and handling the problem do exist. These processes and all other processes used at the planning department are presented in a document updated less than a year ago (Arla Foods CNOSE 2011). The document includes process charts and descriptions on a detailed level so that they could be easy to understand for everyone regardless of if one wants a brief conceptual overview or a hands-on description for one’s operative work with the processes. Although the processes exist on paper, it seems like the planners are not aware of it. Two of the most experienced planners on the department were especially questioned concerning this. The first of them said that they in general did not have any specific processes they followed and especially not when it came to working with “960 transactions” (Planner-I Arla Foods 2012). The second planner is of the same opinion regarding the work with 960 transactions (Planner-IV Arla Foods 2012).
“The work [with 960 transactions] is performed case by case without any specific processes or distinct framework.” (Planner-I Arla Foods 2012).14

“Our work [with 960 transactions] is based on instincts and everyone does it differently ... it does not exist a process description that tells us what to do.” (Planner-IV Arla Foods 2012).15

However, this is not an image that is shared from project managers and planning managers on the department. All of them are aware of that a process exist and most of them also believes that the employees are following the process in their daily work, even though indications have shown that the execution of the process deviates from the recommendations (ProjectManager-II Arla Foods 2012) (Arvidsson Arla Foods 2012) (Jardal Arla Foods 2012) (Carlsson Arla Foods 2012).

5.2.7 Follow-up
The department of Forecasting & Planning has today only one report to follow-up on the wastage figures (ProjectManager-II Arla Foods 2012). This report is a weekly report consisting of an Excel file with ten different sheets full with tables and charts. The sheets display trends, accumulated results over the year and more specific information of the previous week. All figures are sliced in teams, FVCs and product categories (these categories are different from how Arla Foods usually categorizes products). The only possibility for the planners to use the report is to work with the articles featured at the top ten list. The head of Forecasting & Planning expresses that the current report is aged and is not responding to the function he want the report to fill (Jardal Arla Foods 2012). The format of the report makes it hard to get a quick overview of the situation and the way the data is presented does not make it possible to take actions for the future from it, but only to see historical data (Jardal Arla Foods 2012). Another problem with the report is that it is created by multiple manual operations and only one person on the department knows how to create the report (Jardal Arla Foods 2012). The project manager responsible for the reports agrees on that the report is aged, but have not had the time to update neither its design, user friendliness nor content (ProjectManager-II Arla Foods 2012). Both planning managers have requested a report that their planners can use on a daily or weekly basis to enable a quick response to wastage while the problem is fresh, to make sure that the articles with negative trends are caught and to provide a tool that makes it easier for the planners to work with the wastage. This format should lead to an increase in time that each planner puts on work with wastage related issues (Arvidsson Arla Foods 2012) (Wahlström Arla Foods 2012).

14 Translated from Swedish quote: ”Arbetet bedrivs från fall till fall, utan några egentliga processer eller uttalade ramverk”.
15 Translated from Swedish quote: ”Vi arbetar [med 960-transaktioner] på känsla och alla göra olika … det finns ingen rutinbeskrivning som säger vad vi ska göra”.

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5.2.8 Summary

Several areas have been found dysfunctional from a wastage perspective. The dysfunctionality exists inside of the individual areas of interest, in the interface between the different areas of interest and as a chain reaction throughout the process. The main problem seems to be that the initial article set-up and/or the flexibility of the article set-up has not been good enough. The article set-up is of course a big part of this problem, but the article set-up is not the root cause of the problem – it is just a very visible symptom. The article set-up and the customer set-up are not optimized based on total cost, but rather set-up to different departments. The empirical study with all interviews has shown that Arla Foods CSE is a company with a high degree of sub-optimization and lack of communication between different departments. Arla Foods CSE is aware of this and is currently undergoing a couple of projects to improve this (Jardal Arla Foods 2012) (ProjectManager-III Arla Foods 2012).

Besides previous mentioned problems, there are also some handling errors from the planners that make the wastage costs higher than necessary given the current circumstances. These errors occur both because they are not following the specified process and because they are down-prioritizing actions that could lead to lower wastage costs.

The upcoming chapter will discuss possible solutions to the main problems described: sub-optimization and an unstructured process/lack of prioritization.
6 Analysis

This chapter is a presentation of suggested solutions to prevent or reduce the waste drivers identified in chapter 5. The suggested solutions are divided in two different subgroups directed to solve the two main problems – sub-optimization and an unstructured process/lack of prioritization.

6.1 No sub-optimization - total cost in focus

A large share of a solution to the problems of sub-optimization is in the hands of top management, which should be responsible for creating and guiding an organization that has Arla Foods’ result on top on the priority list and not the own department’s result. However, how to create an organizational culture that encourages this behavior will be left out of this thesis and focus will instead be put on concrete improvement actions.

6.1.1 Adjustments in article set-up

The article set-up is far from optimized as the empirical evidence has shown and this is of course an area that needs attention. There are some things needed to maximize the improvement of article set-up while at the same time minimize the work load for doing this. These needs will be presented one by one followed by a suggested solution.

A limited selection of articles to go through

The eight planners for Special Products are at the moment responsible for approximately 550 articles which equal an average of almost 70 articles per planner. The marginal workload for the planners going through the article set-up will for most of the articles be disproportionate compared to the marginal result it will generate.

Solution: A rule that has been proved to be successful in similar situations is the Pareto principle\(^{16}\). In this case it means that fixing 20 % of the articles will solve 80 % of the problem. If this rule is followed it would give the planners approximately 15 articles each to go through which is a manageable number of articles. Data extractions of wastage costs from the period 2011-06-01 – 2011-12-31 shows that 20 % of the articles have stood for 55 % of the total wastage costs. This is however not a completely relevant measurement since some amount of wastage is natural and needed to avoid huge dips in delivery performance. If the wastage target (cost) is split up in equal parts and deducted from each article's wastage cost, the same measurement shows that 20 % of the articles have stood for 80,4 % of the excessive wastage costs. This is of course not a true measurement either because of that the wastage target could not be equally distributed over all articles, but it indicates that the limited selection is good enough.

\(^{16}\) Quality management expert Joseph Juran realized that Vilfred Pareto’s finding that 20 % of the people had 80 % of the wealth was applicable on a multitude of other areas. One of the areas was quality where 20 % of the defects often cause 80 % of the problems. He named it the Pareto principle to honor Pareto (Bunkley 2008).
One problem of only considering wastage cost is that some articles naturally have higher wastage cost due to that their sales volume is much larger than an average article. A way to avoid the problem is to select articles from different problem groups e.g. high wastage value, high wastage frequency and high wastage percentage.

A structured way to analyze the articles and take action – there are a number of parameters that could drive wastage and each planner would probably take a different approach and look at different parameters. This may lead to major wastage drivers being overlooked. The same reasoning can be applied on what actions to take. Suggestions of “best practice” standard actions will eliminate the risk of efficient actions being neglected. This will also create clarity on how to communicate between the different departments and functions.

Solution: To make sure that all aspects are considered in both finding and solving problems, a checklist can be used. The checklist should help the planner through a step-by-step analysis where each step is accompanied by a suggested action. Several parameters that frequently have driven wastage costs were found during the data gathering in section 5.1. A few additional parameters have been added to those and the complete list is presented in table 3 with both problems and primary solutions.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Problem</th>
<th>Primary solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forecast</td>
<td>The forecast is incorrect repeatedly which drives the planner to order more goods than what is needed, leading to wastage.</td>
<td>Communication with the forecasting team that in turn must see if the flaws are in their forecasting model, if it comes from the commercial side of Arla Foods or if it comes directly from the customers.</td>
</tr>
<tr>
<td>Day distribution</td>
<td>The forecast may be correct on a weekly basis, but the sales are distributed in another pattern over the week than what is currently forecasted in the system. Articles with short shelf life will suffer and generate wastage if goods are ordered to sell the main part of the volume in two days, but instead have to wait almost a week.</td>
<td>Correct the day distribution according to the current sales pattern.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Problem</td>
<td>Primary solution</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Safety stock</td>
<td>The safety stock is meant to act as a protection from volatility in demand and supply. If the safety stock is at a level too high, the goods will not have shelf life long enough to be sold within time as soon as the company receives the slightest fall in demand.</td>
<td>Correct the safety stock to a level that is more suitable. Do not think of the safety stock level as units in stock, think of it as days of supply (see section 2.4.2). This approach is more dynamic and lets the safety stock level follow the demand.</td>
</tr>
<tr>
<td>Batch size</td>
<td>Batch sizes have traditionally been decided by the production sites and are set to optimize the production (set-up time, wastage in the production process etc.), but a too large batch size will drive wastage because the accumulated demand during the batch’s shelf life is smaller than the batch.</td>
<td>This is one of the parameters where the focus must shift from optimizing production costs to optimizing total cost. It could be more expensive to trash finished and packaged goods at a FVC than the extra production costs from a smaller batch. Start a dialogue with the production site and the product manager.</td>
</tr>
<tr>
<td>Delivery frequency</td>
<td>Basically the same reasoning as for batch size. Too long time interval in between deliveries will drive wastage by two reasons: 1. The forecast becomes more inaccurate over longer periods and corrections cannot be made as often. 2. The article’s shelf life could be too short to survive the whole time interval plus time added for safety stock (which need to be higher the longer interval).</td>
<td>This is one of the parameters where the focus must shift from optimizing production costs to optimizing total cost. It could be more expensive to trash finished and packaged goods at a FVC than the extra production costs from a more frequent production. Start a dialogue with the production site and the product manager.</td>
</tr>
<tr>
<td>Days to customer</td>
<td>Arla Foods has a general agreement where it is stated how many days before the expiration date the customer should receive the goods. It may cause trouble if the customers have too large share of the total life time of the article. This parameter is not itself a main wastage driver but in combination with other parameters in this table, it could worsen the situation a lot. If the FVC got one or two days extra it could solve many problems.</td>
<td>Start a dialogue with the product manager to see if it is possible to make a change. See if other similar articles have the same distribution between FVC and customer.</td>
</tr>
</tbody>
</table>
Demand volatility

Demand volatility in general is a wastage driver because it makes the forecasting harder and the planning unpredictable.

Demand volatility is especially damaging when it concerns articles with small turnover and a large part of the sales at one FVC tied to one single customer.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Problem</th>
<th>Primary solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand volatility</td>
<td>The general demand volatility is not an issue that the planner need to address, but when it concerns the articles with small turnover the planner has three actions that can improve the situation: 1. Arrange the set-up so that the complete stock is on one FVC and distributed when ordered. In this way there are more customers and the single customer’s demand volatility evens out. This will add an extra day in customer lead time. 2. Arrange the set-up so that the article is made to order. This will not generate any wastage, but the customer lead time will be longer and the production costs will be increased. 3. Start a discussion with the product manager to see if it is possible to delist the article.</td>
<td></td>
</tr>
<tr>
<td>Ordering multiple</td>
<td>This is one of the parameters where the focus must shift from optimizing production costs to optimizing total cost. It could be more expensive to trash finished and packaged goods at a FVC than the extra production/distribution costs from a lower ordering multiple. Start a dialogue with the production site and the product manager.</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 - a summary of the parameters with great importance to wastage prevention. Each parameter has an additional explanation of what problems that could occur and what action the planner could take.

Compliance from other departments and functions – when the planners have tried to communicate with other departments historically, they have seldom been taken seriously and their suggestions have always been rejected (Planner-I Arla Foods 2012) (Planner-II Arla Foods 2012). This has been the case independent on how relevant their suggestions have been and that is not desirable when the aim is to minimize Arla Foods CSE’s total cost.

Solution: It is crucial to have specific communication channels where everyone included in the chain of communication are informed of what they are supposed to do and that they always put total cost optimization in front of sub-optimization. The chain of communication should in general be as follows:
1. The planner discovers a flaw in the article set-up.

2. Communication via email, telephone or in person to one or more of the following roles: forecaster, production manager, product manager.

3. These roles should if needed communicate further with other roles within sales, marketing, production etc.

4. After an action is taken or actively decided not to be taken, the answer and motivation should be communicated back to the planner.

The product manager has the task to weigh costs, risks and opportunities of different departments in a way that maximize the profit for Arla Foods.

Tools to make the analysis easier – to go through all data in search for patterns and signals that indicates an erroneous parameter could be very time consuming. Hence it is important that the planners have access to tools that help them analyze the articles.

Solution: Some basic parts of the analysis can be performed in a standardized way with Excel based tools making calculations based on data base extracts. Several Excel tools already existed, but were underutilized, and spread among the department’s common folders and files. Three of the tools were selected due to their appropriateness to increase the pace of an initial analysis like this one. The three tools are described below.

The first tool (Prognos 7.2, figure 15) is for one thing only – checking how the current day distribution (set-up in system) is in comparison to the actual day distribution (based on sales). This tool gives the planner a strong recommendation on how the parameter should be changed in the system.

<table>
<thead>
<tr>
<th>Article</th>
<th>Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>7091</td>
<td>316</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day</th>
<th>Current</th>
<th>Calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12.41</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>14.17</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>18.06</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>19.85</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>3.58</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>13.87</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td>18.06</td>
<td>25</td>
</tr>
</tbody>
</table>

Figure 15 – the left column shows how article 7091’s day distribution is set-up at FVC 316. The right column shows how the day distribution should be, based on recent sales patterns.
The second tool (Täcktidsanalys, figure 16) is also for one thing only. This tool checks how many days of sales the stock covers at the moment and from a historical view. This helps the planner to spot trends in sales and the need to correct the safety stock level.

![Graph showing days of sales](image)

Figure 16 - here one can see that the analyzed Creme Fraiche article had a stable inventory level of 1-3 days of sales until it suddenly increased to 4-9 days. This rise could either be because of a demand fall, a larger batch size/longer delivery intervals and/or a higher safety stock level.

The third tool (Analysverktyg, figure 17) is the most complex of them. The tool gives the planner a good view on how different parameters brought up in this section cooperate. The tool has been slightly redesigned to include almost all of the parameters in the article set-up that could drive wastages. After all parameters are inserted the output will be if the shelf life for the product is long enough to avoid wastage costs on an average inventory turnover.

![Image of tool](image)

Figure 17 - the planner gets the opportunity to insert information about the product, production and logistics. The row will present the maximum and minimum number of days it would take for any goods to be delivered to a customer. The example article shows a case where the customer has an agreement of 16 days, but some goods will be older than that under the current set-up.
Traceability and follow-up evaluation – some sort of documentation is needed to increase the possibilities to learn from actions taken and keep the knowledge despite changes in personnel. This documentation must be standardized in a way that makes it easier both for the writer and the reader.

Solution: Documentation is necessary to keep the knowledge inhouse even when personnel changes are becoming more frequent. Still this must be done in a way that is not too time consuming for the planners. This could be solved by using the checklist as a template for documentation. The only thing that is needed is checkboxes, fields to insert comments and a standardized structure of naming and saving. Figure 18 shows a part of a suggested template and the complete template is found in appendix B.

![Image](image.png)

Figure 18 - extraction from article analysis template.

The template has been developed with continuous feedback from planning manager Special Products, Per Arvidsson and one of the project managers. The template was tested by six planners and without any major changes requested afterwards.

When the initial clean-up is finished the most troublesome articles is supposed to have an optimal set-up, but the work does not end there. Demand patterns, conditions for other departments, article range and many other parameters will change over time and so must the article set-up too. This means that there is a need for a continuous maintenance work to make sure that the article set-up is up to date. This maintenance should for simplicity be performed in a regular pattern. It could either be done more seldom (monthly or quarterly) with a longer list of articles to go through or more often (weekly) with one article at a time. Another option is to perform the analysis as soon as an article has shown a trend of high or increasing wastage costs over a longer period of time.
6.1.2 Incorporation of wastage costs in financial reports

Today when an article’s performance is reviewed from a financial aspect, the wastage cost is not included in the financial report and hence not considered when the product manager decides the destiny of the article (Jardal Arla Foods 2012). The decisions will then be based on incomplete information and wastage costs will at the best continue to lie on the same level as before and at the worst increase heavily. A natural solution to this problem is to include wastage costs in financial reports and as a result increase the quality of the decisions. This problem has been observed and discussed a long time among both managers and planners at the planning department and steps are now being taken to develop a systematic change in the financial reports (Planner-I Arla Foods 2012) (Jardal Arla Foods 2012). The same unawareness of wastage costs is present in one of the earliest stages in the product lifecycle – just before the launch of the product. Article set-up, pricing and everything else is based on expected sales, production costs, marketing costs and several other factors, but wastage costs are not included in this calculation, which is wrong by two reasons. First, very few products have wastage costs close to zero and especially not in connection to a launch (described in 4.2). Second, the wastage costs are highly connected to the article set-up so the chosen article set-up’s affect on wastage costs must be analyzed and compared to other possible set-ups. To implement the wastage cost in the calculations before launch is also a project that is ongoing at the moment (ProjectManager-III Arla Foods 2012).

If the projects are carried out as planned it will create a better situation for the planners in two ways. The first and most obvious way is of course that the product managers will make decision based on a more complete image than they did before. This will give the articles better starting conditions (from a wastage perspective) and the product manager will follow up on how the costs develop when changes occur in demand and are made in supply. However, the product manager will still not be an expert in interpreting exactly what factor drives wastage costs or how different changes may affect the costs in each unique case – but the planners do, which leads us to the second advantage.

The second, and not as obvious, advantage is that this will lead to a strengthen connection between the product manager and the planning department. If the product manager sees how wastage costs affect the article’s performance the receptiveness of information and suggested actions from planners will increase. When a planner finds an article with high wastage costs caused by e.g too large batch sizes and turns to the product manager with a request for smaller batch sizes, the product manager will be able to see how the reduction of wastage cost will affect the total performance of the product. This is figures that do not exist in the financial reports today and hence will, possibly, be neglected by the product manager who only sees how the article performance is affected by higher production costs. The planners may even be asked to investigate what could be done and what effect it will generate in certain cases, which would even more encourage the communication between the planning department and the product managers. The product managers that already have a strong connection with the commercial side and the production sites will now have a realistic opportunity to succeed with total cost optimization and not allow sub-optimization.
6.1.3 Adjustments in customer set-up

The problem of different customers having different agreements when it comes to freshness is known outside of Planning & Forecasting as well. Peter Andersson, project manager at customer service, states that he clearly is against the differentiation in the agreements (Andersson Arla Foods 2012). Andersson even uses the word “garbage” to describe his opinion of having different agreements to different customers.

Even though the differentiation is a major problem for the planners and forecasters, a part of it must be maintained. Wholesalers must have a few days more to sell the products than the retailers, because otherwise the wholesalers would not be able to shift the products out to their customers before the expiration date is too close. However, what should be done is to direct some attention on the customers with individual agreements without being wholesalers. How much extra revenue does Arla Foods CSE gain by offering these agreements and how is it in comparison to the loss caused by wastage? As far as Peter Andersson knows nobody has done that calculus before offering agreements (Andersson Arla Foods 2012).

If the decision, one way or another, will be to keep all agreements the same as they are today, Arla Foods CSE’s challenge will then be to minimize the risk of wastage because of this factor. Two actions that could help to obtain this are:

1. Demanding more frequent and accurate forecasts from the customers. The insecurity will be smaller if future orders could be foreseen.

2. Requesting systematization of the ordering so that the orders are placed in a predictable way at e.g. a specific time interval. This would make the planning of both production and inventory easier.

6.2 More structure and higher priority in daily work

Arla Foods CSE is as most other companies so “slimmed” that the employees do not have the time to do everything they want or could do. The ulterior motive is that the employees only should do activities that add more value to the company than their own cost of labor. This is why prioritization is so important in the daily work of a planner. Since the value of each action is hard to measure; the priorities should be based on a strategic direction. Top management at Arla Foods CSE has pointed out that wastage costs should be one of the most prioritized areas to work with (Greve Arla Foods 2012) and that is why prioritization is highlighted in this thesis. The work to reduce wastage costs should be as structured as possible to utilize the time and maximize the efficiency of work.

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17 Translation from the Swedish word ”skräp”.
6.2.1 Education in the stipulated process
Interviews with planners have shown that they are not aware of any stipulated process on how to perform their daily work in general and particularly not daily work with intent to prevent wastage. However, these processes exist and it is vital that the processes are followed. One process does for example state that all internal transfers between FVCs and/or other actions affecting forecasted inventory levels should be done before any replenishment order is placed. However, observations and interviews have shown that this is not always considered among the planners (Planner-I Arla Foods 2012) (Planner-IV Arla Foods 2012). To eliminate this risk of causing unnecessary wastages all planners need to be thoroughly educated in the process. The education should not only focus on how but also, and more important, on why. It is a crucial success factor that all planners understand why the steps are performed in a certain order and what might happen if the order is reversed or forgotten.

6.2.2 Transfer between FVCs
One process in the section above concerns what to do when a batch appear as a 960 transaction – an information that the batch has a quantity which will exceed the last sales date without being sold (according to forecast). Analyzed data extractions indicate in section 5.1.3 that it is not unusual that goods have been trashed at one FVC when they could have been sold at another FVC. The stipulated process tells the planner that the batch should be moved to another FVC if it could be sold there (Arla Foods CNOSE 2011). Even if the planners know the process or will know it after education, there might still be a resistance to transfer the goods since the transportation of course only should happen if the revenue of the sale exceeds the costs related to the transfer. To make the decision easier for the planners they could use general guidelines on what quantities is profitable to transfer.

The quantification could be resolved by using a formula that seeks the weight where the total cost equals the total revenue:

\[
\text{Total cost related to transfer} = \text{Revenue per kg} \times X \text{ kg}
\]

\[
\Rightarrow X = \frac{\text{Total cost}}{\text{Revenue per kg}}
\]

Equation 2 - derivation of an equation aimed at calculating what minimum volume needed to make transportation between FVCs profitable.

The revenue per kg is the article’s average sales price per kg, since the article has no value if it becomes wastage. The total cost includes transportation cost and handling cost. The transportation cost is a fixed cost as long as the transported goods weighs less than approximate 500 kg (minimum weight charged), but varies depending on the route (Lindberg Arla Foods 2012). The extra handling cost is the labor cost of the work performed by the planner and the extra work performed by employees at the FVCs. The labor cost is based on an average salary and expected time spent handling the transfer. The formula has now taken this shape:
\[ X = \frac{T + C}{P} \]

\[ T = \text{transportation cost} \]
\[ H = \text{handling cost} \]
\[ P = \text{average sales price} \]

Equation 3 - equation aimed at calculating what minimum volume needed to make transportation between FVCs profitable.

However, this formula does not consider risk. Given a perfect scenario where the planner knows for 100% certainty that the goods will be trashed at the first FVC and will be sold at the second FVC, this formula is perfect. Since this is not the case at most times, there is a need to incorporate risk parameters \( q \) and \( p \), describing exactly this. This leads us to the formula:

\[ X = \frac{(T + C) \times \frac{1}{q}}{P \times p} \]

\( q = \text{probability of wastage at the sending FVC} \)
\( p = \text{probability of sale at the receiving FVC} \)

Equation 4 - equation aimed at calculating what minimum volume needed to make transportation between FVCs profitable. This equation has also incorporated the risk of misjudging the situation.

This formula could then be applied on standard categories and used by the planners. Given that \( T \), \( C \) and \( P \) are fixed (\( P \) is of course variable, but the planners do not have access to this information so a general, fixed, value is applied on each category) the only parameters that the planners need to adjust is their confidence in their actions (\( p \) and \( q \)). In this extraction from an example (figure 19) standard values of \( p \) and \( q \) are used (\( p = 0.7 \) and \( q = 0.9 \)). The complete example could be found in appendix C.
### 6.2.3 Discounted sales of excessive goods

Although a selling process of goods with expired last sales date exists (see section 4.2.1 about HDS), the process acts only as damage control and a last way out. As we have learnt earlier, the planners have access to a warning system (960 transactions) that indicates a most probable need of wastage in the future. If there is not a possibility to transfer the goods to be sold at another FVC (see above), you still have a few days to do something with the goods before the last sales date is passed and it becomes available for HDS.

A suggestion is to develop a similar process as HDS for excessive goods that either way most certainly will show up in the HDS process a few days later. The benefit is that in-house sales department will have more days to sell the goods and because of the extra days before expiration they do not have to discount the product as heavily. The risks of cannibalizing on ordinary sales will unfortunately be higher by the same reason – the customer has more days to sell the goods and can hence use the discounted goods as a replacement for an order to regular price (especially retailers with high inventory turnover that seldom need to use all days possible to sell the goods). Even though this still is the most profitable option for Arla Foods in the short term it may in the long run conceal the root of the problem and may hence not give the same urgent incentive to chasing for a solution (Arvidsson Arla Foods 2012).

Henrik Nilsson (2012), inhouse sales manager, is positive to the idea of developing this kind of process and believes that there is a market for these kinds of deals. However, his department does not have the resources for this at the moment (not even to do a thoroughly job with current HDS) without downsizing the regular work (Nilsson Arla Foods 2012). The extra revenues must be greater than the extra costs of hiring another employee for example.
Measurements were therefore conducted to explore how much goods that are eligible for this kind of process. Samples were taken at different days and in different weeks to get a fair image on how the situation is. Only batches that fulfilled the requirements (days left, volume and price) for HDS were considered. The result was that an average week’s 960 transactions fulfilling all requirements had a total cost price of 150% of an average week’s wastage. This does not even include all the goods with small batches, low value or a few days left. The number is bigger than 100% because goods that will be sold in a HDS process is included and so is goods with long shelf life where the customers still accepts fewer days than agreed to regular price as well as goods that are sold to regular price before deadline due to an unexpected increase in demand. The number is however so high that it is definitely a huge opportunity to reduce wastage costs and increase revenues, so developing a process aimed at selling the excessive goods before it is too close to wastage is something that needs to be considered and investigated more thoroughly. If more goods could avoid wastage it will also benefit Arla Foods’ Closer to Nature vision of zero wastage.

6.2.4 Design change of follow-up reports
The follow-up reports are currently designed in a way that only acts as a summary of previous week’s wastage costs without possibilities to use the report as a tool in the work against wastage (this is discussed in section 5.2.7). A new design on the report should be added to make it easier to work with wastage reduction in the daily work on planning level and to get a quick overview on management level. The different stakeholders had some conditions that the new report design should fulfill. The conditions will be presented one by one followed by a solution.

Easy to create – the report has up to now been created by manual insertion of data. The data does not come directly from one Lusa extraction – it is either processed or based on several Lusa extractions. This takes time to do and training to learn.

Solution: A macro in Excel can process the data and create the report by itself as long as all information is available in the extraction from Lusa. The only thing the macro cannot do easily is to insert the data to produce showing accumulated costs and trends.

A quick overview on the current wastage situation and trends – a person that is interested in how the current wastage situation is should be able to find a clear and understandable answer.

Solution: First of all the format of the report needs to be changed. An Excel file with ten sheets is not user friendly and it is hard to navigate through the sheets and find the most relevant information. The report should instead be a PDF file only including the information needed to get a quick overview. The current report includes eight tables and 17 charts, which is way too much if you only want a quick overview. By removing information, combining charts and only using charts – the result is a report that includes only ten charts presented on four PDF pages. You find a complete report in appendix D.
Easy to work with for the planners – the report should not only be giving a quick overview, but it should also work as a tool for the planners in their work to reduce wastage costs.

Solution: In addition to the PDF report that is communicated to persons in a wide variety of functions and levels, two pivot tables will be created for the planners. The pivot tables have the purpose of giving the individual planner a snapshot of the wastage results of their articles. The first pivot table will display wastage costs and the second pivot table will display wastage as percentage of sales. Both pivot tables will be structured the same way; the table will be sorted by planner and the articles’ results will be shown in order of total cost/percentage. The result will then be split up into each of the nine FVCs. When the planner clicks on a button in the sheet, a macro will run conditional formatting on the sheet and the planner will have wastage costs/percentages over a pre-determined value highlighted, which indicates that some sort of action needs to be take (see figure 20).

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Figure 20 - the report should enable the planners to easily spot problems and take quick actions. This is in SEK, but an identical report displaying percentage of sales exists.

A separate report can be created, with the same functionality and design, to show how the wastage trend of each article develops. An example of how this is shown below in figure 21.

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Figure 21 – an additional report displaying how the trend is from week to week at each FVC.
Applicable on different periods – a weekly report is not enough. Daily, weekly and monthly reports are wanted as well as the possibility to create a report on a customized period. Daily reports allow and encourage quick actions on identified problems. When the report is easy to create there is nothing that stops it from being run on a daily basis.

Solution: If all charts are created to only display actual figures, there will not be a problem to run the same macro with input data as the only variable parameter. Since the macro cannot sense if the inserted data is covering a day, week or month the easiest solution is to always create a daily, weekly and monthly report and let the user decide which one to save depending on the time period the data covers. The daily report does not necessarily need to include all charts since the only point of this report is to find urgent problems. The two sheets created for the planners to work with only need additional buttons (macros) that are controlling conditional formatting for appropriate values given the time period.

6.2.5 Send food to charity instead of trashing it
Arla Foods have charity work in several countries where they cooperate with charity organizations distributing the food to people and institutions in need. Examples of this are Canadian organization Second harvest, German organization Tafeln, St George’s crypt in Great Britain and Manna Pankki in Finland, all of them are distributing food to shelters, hospitals, schools and other people in need (Arla Foods 2012c). This is something that Arla Foods CSE could be a part of as well. The distribution costs would not be greater than the costs related to trashing the goods. Sure, some organizations and institutions would have bought products from Arla Foods anyway and this will of course affect Arla Foods CSE negatively in shape of loss of sales. However, the Arla Foods brand will generate a lot of goodwill by doing this; both because the company practice charity work and that they do not waste natural resources. This would strengthen their trademark slogan Closer to Nature.

6.3 Other areas
Some suggested actions could not be sorted under any of the two main areas so they will be described here instead.

6.3.1 Work towards ECR
Arla Foods CSE has currently no plans on taking steps towards a more integrated relationship with their customers (Andersson Arla Foods 2012). The forecasters and planners do not communicate with the customers in any organized way, and the communication they have is often retroactive (discussing what went wrong) instead of proactive (creating opportunities to avoid future problems) (Larsson Arla Foods 2012). The technical integration between Arla Foods CSE and their customers are limited to EDI connections. Orders, order acknowledgements and invoices are all sent via EDI in many cases to lower ordering costs (Andersson Arla Foods 2012).
Since ECR has been proved successful in so many cases, a suggestion is that Arla Foods CSE starts to move towards it. The problem is that neither Arla Foods CSE nor the customers has willingness to take the risk connected to developing the ECR system. Skepticism of letting systems perform the work that persons do today is present internally as well as externally (Andersson Arla Foods 2012). When referring to reports stating that ECR works absolutely fine in the food industry, the response was “but have you read any reports concerning dairy products in specific? These products are special” (Andersson Arla Foods 2012). And since only one customer (a wholesaler) has requested an implementation of ECR, the pressure from customers is non-existent.

Going directly from the current system to ECR would, as observed, cause lots of internal protests, so this is probably not the most psychological way of doing things. Besides, it would be hard to convince the customers to take that huge leap of faith. It is also connected to large investments when implementing new software and connections between Arla Foods CSE and the customers. So a suggestion for a first step to a closer and more integrated relationship with the customers is to start establishing ways of exchanging information concerning forecasts (customer) and production/inventory situation (Arla Foods CSE). This would give Arla Foods CSE better opportunities to plan their inventory levels with a high accuracy and hence avoid wastages. The customer could at the same time use the information of Arla Foods CSE’s inventory levels to order goods in advance when inventory levels are decreasing.

From this stage, the step to a fully integrated ECR relationship would not be as far as it was before. One problem still remains, though – planners at both Arla Foods CSE and the customers might be unwilling to take even small steps towards automatization since this will lead to a rationalization of their own jobs (Andersson Arla Foods 2012). This is always a challenge, but Arla Foods CSE must explore this path sooner or later and it will generate positive effect on the result.

### 6.3.2 System

The system related issues that were brought up as wastage drivers are planned to be solved as a part of the implementation of a new ERP system (Carlsson Arla Foods 2012). The change of ERP system will take place shortly after this case study and these issues will hence not be processed further in this study.
6.4 Summary – recommendations to Arla Foods CSE
This section is direct recommendations to how Arla Foods CSE should approach the problems with high wastage costs. All actions are described in the material above, so this will only be in short.

Short term:
- Make a thorough clean-up among the worst performing articles to make sure that they have an article set-up with conditions to avoid excessive wastage costs.
- Educate all employees in the current process and why it is designed the way it is. Hold workshops and discussions concerning priorities and how to work with the problems.
- Start transferring goods between FVCs more frequently when profitable, instead of trashing goods.
- Start using follow-up reports that is easier to retrieve information from for all concerned. The reports should include segments that give the planners direct information of current problems and data to take a quick action.

Long term:
- Develop a culture within the company where communication in between the departments is natural and appreciated.
- Evaluate the profitability of selling excessive goods to a discount and develop a process if profitable. The system should be similar to HDS.
- Evaluate possibilities of sending excessive food to charity.
- Start to shift the current system towards ECR. The company has all possibilities to succeed in a shift to ECR, but this must of course be evaluated further.
7 Concluding discussion

This chapter is meant to discuss the study’s findings and their connections to the theoretical frame of reference. The research questions will be answered and future research topics will be suggested.

7.1 Discussion

The original intention of the thesis was to investigate how different planning principles within SCM and inventory management were applicable on companies and industries that handle products with short shelf life. This is what the literature review has been focused on and therefore the theoretical frame of reference as well. The case study did however take the research into another direction. The new direction took the research to a path leading to problems related to work processes, organization, communication and strategy. This was because of two reasons:

1. Planning principles do not play the same role in a company where the products have a short shelf life. Calculations of safety stock levels and delivery patterns cannot be stabilized on an optimal level for the long run since the demand is too volatile and the products get obsolete relatively fast.

2. The case company was not mature in the aspect of processes, organization and communication which made the problems related to planning principles insignificant compared to this – those problems still exist and much could probably be improved. The planners have the needed competence and access to relevant tools, but when this is not incorporated in their daily work nor appreciated in the organization, it is pointless. In addition, some actions connected to planning principles, like ECR, is not possible to implement due to the lack of maturity.

However, the case study has clearly established the general view of how sensitive a company in the food industry is for fluctuations in demand or disturbances anywhere within the supply chain, which of course is directly correlated to the inability to keep sufficient safety stock due to the short shelf life of the products (Gerogiadis, Vlachos and Iakovou 2005). Another important factor that made the case company sensitive is their inflexible production, which theory already has described as a general problem for the industry (van der Vorst, van Dijk and Beulens 2001). Whenever these fluctuations or disturbances occur, the result will be a bullwhip effect damaging the whole supply chain (Lee, Padmanabhan and Whang 2004) (Chopra and Meindl 2001).

The research questions will now be reviewed and answered in the light of this.
Which factors drives wastage costs at a global dairy company such as Arla Foods?
On a detailed level, several parameters connected to the article’s set-up were identified as possible wastage drivers: forecast accuracy, day distribution, safety stock level, batch size, delivery frequency, selling days for customer and ordering multiple. At the same level of detail, the case study revealed that customer unique agreements were a wastage driver due to the increased difficulty to perform demand forecasts.

On a less detailed level empirical data from the case company has shown that the bullwhip effect could be even more volatile than usual when substitutes are available. Slack, Chambers and Johnston (2007) has found that the obsolescence due to the existence of substitutes is often underestimated. This is due to a large share of consumers rather will purchase a substitute from their regular grocery store than go to another store or wait until the product is back on stock, which makes the demand seem higher than it actually is. This indicates a great need to have a dependable supply and correct information/forecasts of current and upcoming demand. The study has also shown that holidays and product launches are the time periods which generate peaks of wastage costs because of the difficulties of planning and forecasting those events.

A macro perspective has given us the two most salient wastage drivers – (1) strong tendencies of sub-optimization and (2) processes not being followed as well as lack of communication and prioritization. Sub-optimization is affecting the parameters of the article set-up and hence the article’s possibilities to avoid wastage. When processes are not followed it will both take time from the planners and also drive wastage when e.g. an article is trashed at one FVC while it has a stock out at another FVC.

How do the factors relate to each other?
The case study has created an understanding of that all these factors are connected to each other. A too large batch size could for example be a symptom of sub-optimization and lack of communication, which could have been solved if the processes were followed. Most of the factors are however a symptom of the lack of structure and/or lack of communication.

When it comes to comparing and quantifying different factors, this case study’s contribution is from the parameters in the article set-up identified by the planners in the two analyses described in 5.1.1 and 5.1.2. The first analysis shows that the planners perceive various forecasting deviations to cause single peaks in an article’s wastage cost. The forecast deviations could either be unexplained, due to a sudden decrease in sales or due to a misjudgment during a product launch/campaign. The various types of forecast deviations is stated as the reason in 56 % of the cases and 68 % if eliminating the uncommented cases. In the second analysis, which is looking into structural problems on articles where the wastage cost is high over time, the planners perceive too large batch sizes to be the largest problem. Together with the closely related delivery frequency they make up 36 % of the stated reasons.
What actions could be taken to reduce the wastage costs at a global dairy company such as Arla Foods?
When it comes to what actions that could be taken at the case company, actions related to processes, organization and communication will be dominating. Some more traditional actions, related to planning principles, where however found and will start this review.

As the observant reader can notice, the theory on hand includes mostly description of phenomena and not really solutions that are applicable on a company similar to the case company. Many solutions are based on longer shelf life and/or a lead time between company and customer, which is nonexistent at the case company. What remains is one huge, revolutionizing solution called ECR developed by academics and specialists within the food industry. ECR is a further development from QR (Fiorito, May and Straughn 1995) specialized on food industry and was originally developed because the traditional EOQ formula did not cope with the needs of the fast moving industries (Zinn and Charnes 2005). ECR is a solution to problems related to bullwhip (Disney and Towill 2003), how much to order and insecurity in demand (Kurt Salmon Associates Inc. 1993). The basic thought behind ECR is that ordering costs should be almost zero and complete focus will be on minimizing inventory costs and giving the supplier optimal conditions to plan their own production and deliveries (Kurt Salmon Associates Inc. 1993) (Fiorito, May and Straughn 1995). Implementation of this system would, except for the main purpose of maximizing demand control and minimizing forecasting errors, also solve one of the main problems that the case company experienced. A conflict of interests between inventory costs and production costs are blocking total cost optimization, but this conflict could be heavily reduced if the company is responsible for both production planning and delivery planning. The same delivery day could be used to multiple customers and hence make larger batch sizes possible as well as lower production frequency. Safety stocks could be lower and transportation synergies could be found. The goods can also be delivered to the customers in close connection to the production, so that the customers receive as fresh goods as possible. However, some identified problems could not be solved by just implementing ECR. Product launches and holidays would still be a problem to plan for and the planners still need to learn and understand the correct work process/priorities. Also, the lack of internal communication within a company would not be solved and by implementing ECR the need for internal communication would rather increase. The major problems with a possible ECR implementation that this case study has shown is how skeptic it is received by employees and that basic conditions in organization, structure and communication are not in place. The skepticism occurs from two reasons. The first being general risk aversion from implementing something that is completely new, can go very wrong and far beyond the comfort zone. The second reason is the resistance that people feels when their job might be replaced by an automatic system. These questions are tough to handle and top management must be aware of them before deciding anything.
Another, smaller action, originates from the two big decisions in inventory management discussed in 2.4.2 – when to order and how much to order (Silver, Pyke and Peterson 1998) (Slack, Chambers and Johnston 2007). Since the demand is fluctuating and the shelf life of the goods is short, the most important thing when considering when to order is to think of the safety stock as days of supply and not absolute numbers. Empirical data from the case company has shown that their safety stocks are seldom changed because of their belief in absolute numbers and usage of ROL – which is one of the factors driving wastage. Using a ROL works fine when two conditions are fulfilled; (1) the demand should be stable over time and (2) the goods should have a shelf life long enough to tolerate the shifts in momentary inventory turnover ratio that will be the result. The case company’s products only fulfill the first of the conditions and safety stock levels need to be controlled via ROP. In order to be fair to the planners at the case company, the task of controlling a ROP manually is way too time consuming so this is a feature that must be included in the ERP system.

Except these two solutions connected to planning principle, the analysis of the empirical material has come up with some other actions targeted on decreasing wastage levels through improved structure and communication:

All articles need to have conditions for avoiding both wastages and shortages in a combination that optimize the result of each article regardless of if the parameter needed to change is day distribution, batch size or inventory strategy. It should also be easy to find how an important cost driver such as wastage, affects the article’s result on the financial statements. Structure is needed to prioritize what articles should be analyzed, performing a standardized analysis and document it in way that may help in the future. Communication is needed between the departments in the company to weigh different costs against each other and find the optimal set-up.

A clear and logical process on how to perform the planning process needs to be in place and followed by all planners at the company. The first step must always be to do all changes affecting the planning and then afterwards place orders. If the company has multiple distribution centers, it should always be a possibility to calculate approximate volumes needed to make profit from transportation from one distribution center to another. To have this process means that the work is performed in a structured way. If the process exists but is not followed by the planners, the company must educate the planners in the process and why it is as it is.

The company should always have a plan on what to do when the preventive work has failed and the inventory levels are higher than the demand during the goods shelf life. This plan might be discounted sales (before or after last sales date has expired) or sending the goods to charity, as long as it generate value to the company. A standardized framework should be used to create structure and communication is necessary in between the planning department and the sales department.
Follow-up reports should be designed in a way that makes them easy to work with regardless of if it is top management that wants to have quick updates to draw up strategies or if it is planners that need detailed information to discover minor problems and act on them before they turn in to major problems. All reports should be created in regular intervals and be structured so that it is easy to find the sought information. The follow-up is by itself a way of communicating how the situation is at the moment and what the trend looks like. The communication is needed internally within the planning department as well as externally. Without this communication it is hard to take necessary internal actions or be perceptive to requests.

To what extent will these findings be generalizable?
The literature is much focused on planning principles and other technical matters, but the case company faced completely different kinds of problems. The question of generalizability is then a question of if the case company is representative for the food industry and other companies/industries handling products with short shelf life. The thesis cannot answer this, but given that the case company is one of the largest and most successful dairy companies in the world, they should not be that much inefficient than its competitors. This indicates that the dairy industry are either facing the same kinds of problems in sub-optimization, structure and lack of communication or that the case company excels in their use of regular planning principles compared to its competitors. A possible explanation could be that the food industry is currently facing the same development as Lummus and Vokurka listed as crucial reasons for the development of SCM: (1) increased specialization, (2) increased globalization and (3) increased focus on total cost optimization. These companies often have a large part of the value chain internal and negotiating with internal parties is not the same thing as negotiating with external parties in a supply chain even if it theoretically should be the same. If these thoughts could be applied to the dairy industry it could probably be transpired to large parts of the food industry as well as other industries containing products with short shelf life. The problems that were found during the case study probably exist in traditional engineering companies as well, but the difference is that those companies can rely more on their planning principles. Fast decisions on a day to day basis to avoid wastage are more dependent on processes, communication and structure than planning principles due to the demand volatility and short shelf life of the products.

When it comes to generalization of the solutions it might not be possible to use the exact same solutions as suggested for the case company since each company has its own unique problems and set-up. However, the general mind-set could bring insight and inspiration, because every company will for example need to have a structured way of working with processes, establish conditions for communication and avoid sub-optimization. This is probably valid for all industries, even though the sub-optimization part requires the company to be vertically integrated.
Some of the more technical solutions could be applied on most parts of the food industry. As established earlier, using a ROP instead of a ROL is very important when the products have short shelf life and the demand is volatile. Implementing ECR has been proved to have a high success rate in the whole food industry and should hence be considered by all companies within the food industry (Vergin and Barr 1999) (Tyan and Wee 2003).

This thesis has contributed to the field of SCM and inventory management by illustrating how the existing literature in the field does not consider many of the most important problems faced by the Swedish division of a global dairy company. The case study has shown the importance of processes, organization and communication instead of just focusing on planning principles. This is something that is not mentioned in the literature and instead seen as an own, unrelated field. The thesis has also shown that many of the tools within the theoretical framework are developed for products with longer shelf life, which is not the case for the case company.

7.2 Further research
This thesis is a small contribution to the knowledge on how companies and industries where the products have short shelf life should work with SCM and inventory management. However, the study is just based on one case and there is a great potential for further studies.

It would be interesting to first of all see if Arla Foods’ competitors are facing the same problems or if their problems are more traditionally directed to pure planning principles. This would display if the problems are connected to Arla Foods’ corporate culture or if it is applicable on the dairy industry in general. This scope could then be widened in even further research, performing case studies at companies in other parts of the food industry.

The phenomenon of having relevant competence and tools, but still not utilize it due to lack of communication and prioritization is an interesting question that could be related to corporate culture. It would therefore be interesting to see research from a corporate culture perspective and how it affects performance within SCM and inventory management. Companies form the food industry could then be compared to traditional engineering companies to see if there exists a difference.

A lot of the theory is focused on how ECR is the solution to most of the problems, but is ECR a rational choice for all companies in this situation? It would be interesting to see a study on what result it would have on a company like Arla Foods. Are the implementation barriers too high to capitalize on ECR?

Finally, Arla Foods CSE was, as stated earlier, too immature to be analyzed on a more technical level covering adjustments of specific planning principles. There are probably things to do in that area as well, but that could not be studied at the time. If Arla Foods CSE is embrace the suggested changes and are changing their current methods, it could be interesting to do a new case study at the company and see what other problems that have been hidden this time.
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**Newspaper articles**

**Reports**


Scientific articles


Harris, F.W. "How many parts to make at once." *Factory, the magazine of management* 10, no. 2 (1913): 135-136, 152.


Appendix A – The bullwhip effect

<table>
<thead>
<tr>
<th>Period</th>
<th>Third-tier supplier</th>
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<th>Second-tier supplier</th>
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<th>First-tier supplier</th>
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<th>Original equipment mfr</th>
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<th>Demand</th>
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The table illustrates how a small decrease in demand leads to increasing volatility in the supply chain. Adopted from Slack, Chambers and Johnston (2007)
Appendix B – Suggested template for article analysis

Date:  
Art. No.:  
Art. Name:  
Planner:  

1. Is the day distribution satisfying? 
   Tool: Prognos 7.2.xls 
   If no...  
   Action: day distribution corrected.  
   Additional Action:  
   Decision:  

2. Does the safety stock cover volatility in supply and demand without frequently cause stock outs and/or wastage? 
   Tool 1: Täcktidsanalyse  
   Tool 2: Analysverktyg  
   If no...  
   Action: safety stock level corrected with a Choose an item. to Click here to enter text.  
   Additional Action:  
   Decision:  

3. Is it possible to avoid wastage with the current batch size? 
   Tool: sales statistics  
   If no...  
   Action: communication with production/product manager to investigate if batch size should be reduced, sales should be pushed, wastage be accepted, production to order be implemented, article be abolished or other option.  
   Additional Action:  
   Decision:  

4. Is it possible to avoid wastage with the current production frequency? 
   Tool 1: Analysverktyg  
   Tool 2: communication with the forecaster about the reliability of the forecasts  
   If no...  
   4b. Why not?  
   Action: communication with production/product manager to investigate if production frequency should be increased, wastage be accepted, production to order be implemented, article be abolished or other option.  
   Additional Action:  
   Decision:  

   NO □ YES □

Click here to enter text.
5. Does the current number of days to sell the article give acceptable conditions to avoid wastage?  
   Tool 2: Analysverktyg

   If no...

   5b. Is the number of days the same for similar articles?  
   Action: communication with product manager to investigate if the number of days to sell the product could be increased, transportation lead time be shortened, wastage be accepted, article be abolished or other option.
   Additional Action: Click here to enter text.
   Decision: Click here to enter text.

6. Is the forecasting accuracy on an acceptable level to avoid wastage?  
   Tool 1: Forecasting accuracy report from JA  
   Tool 2: Analysverktyg

   If no...

   Action: communication with the forecasting department for correction.
   Additional Action: Click here to enter text.
   Decision: Click here to enter text.

7. Is the sales volume of the size and stability to have the article on stock at all FVCs?  
   Tool: sales statistics

   If no...

   Action: communication with product manager to investigate if the article should only be on stock on specific FVCs, production to order be implemented, increased forecasting- or stability demands to large customers or other option.
   Additional Action: Click here to enter text.
   Decision: Click here to enter text.

8. Is it possible to avoid wastage with the current ordering multiple (for a single FVC, not batch size)?  
   Tool: sales statistics

   If no...

   Action: communication with production/product manager to investigate if ordering multiple should be reduced, sales should be pushed, wastage be accepted, production to order be implemented, article be abolished or other option.
   Additional Action: Click here to enter text.
   Decision: Click here to enter text.

Other reason(s): Click here to enter text.

Action(s): Click here to enter text.

Other comments: Click here to enter text.

9. Does the article have best possible conditions to avoid wastage after these actions?  

   YES □ NO □
Appendix C – Example of template for calculating minimum profitable weight to transport from one FVC to another.

<table>
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<tr>
<th>Product category</th>
<th>Butter</th>
<th>Margarine</th>
<th>Juice</th>
<th>Keso</th>
<th>Drink-yoghurt</th>
<th>Crème Fraiche</th>
<th>Fruit-yoghurt</th>
<th>Mild Yoghurt</th>
<th>Whip cream</th>
<th>Kesella</th>
<th>Natural sour milk</th>
<th>Flavoured sour milk</th>
<th>Sauces and soups</th>
<th>Cream (Kelda)</th>
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\[ p = \begin{bmatrix} x & x \end{bmatrix} \] Probability that the article will be sold at the FVC you plan to send it to (standard x,x).

\[ q = \begin{bmatrix} x & x \end{bmatrix} \] Probability that the article will be trashed at the FVC you want to move it from (standard x,x).
Appendix D
Weekly report W.15

Costs per team

Wastage cost per product category

Wastage cost per sub-category