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Developing the order fulfilment process in dairy industry

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<p>The need to develop order fulfilment cycle often starts from customers' request. Customers are increasingly demanding short cycle times and they consider short order fulfilment cycle time as a very important factor when choosing suppliers. Leaving order later and receiving order faster is becoming more important all the time. If businesses are able to combine a great product with fast deliveries and late order cut-off times, they will gain competitive edge over their competitors.</p> <p>The purpose of this research was to investigate a case company's current exporting order fulfilment cycle in dairy industry and what sort of adjustments are required to expedite this cycle from three days to two days. The research intended to identify what operational adjustments are needed, how the customer will be affected by the change and what sort of costs may emerge from deploying the change. Furthermore, the costs and benefits of the change were evaluated from point of view of the case company and its customers. The empirical data for the study was collected through observations, surveys and documentation as the researcher was involved with the case company's key processes. To analyse better the possible impacts of the faster order fulfilment, the case company ran a 6-week simulation with faster cycle for one of their customer's.</p> <p>The simulation confirmed that the company is able to operate in a faster 2-day-cycle without the need of major investments or adjustments. The quality of the supply chain was not affected by the change. The main factor for success on the faster order fulfilment will be the succeeding of sales planning and forecasts made by them. Speeding up the order fulfilment cycle holds numerous of significant benefits for both the supplier and the customer with very few costs.</p>	
Keywords	Order fulfilment cycle, Dairy industry, SCM, Quality

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Abbreviations

BI	Business Intelligence
CA	Competitive Advantage
CE	Competitive Edge
CV	Customer Value
DP	Distribution Planning
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
FEFO	First Expiring First Out
FIFO	First In First Out
HoReCa	Hotels, Restaurants and Catering
HRM	Human Resource Management
IOT	Internet of Things
KPIs	Key Performance Indicators
MTS	Make-to-Stock
OFC	Order Fulfilment Cycle
OFCT	Order Fulfilment Cycle Time
PP	Production planning
QC	Quality Cost
RFID	Radio Frequency Identification
ROI	Return on Investment
SC	Supply Chain
SCM	Supply Chain Management
SCP	Supply Chain Planning
SKU	Stock Keeping Unit
SL	Service Level
SM	Stock Management
SP	Sales Planning
S&OP	Sales & Operations Planning
3PL	Third-party logistics

1 Introduction

This thesis is based on the need to develop order fulfilment cycle of a dairy company. The purpose of the study is to analyse the changes which originate from postponing the order cut-off time for the company's customers. Due to the confidential nature of the information involved for this study the companies will be referred as Company X1 and Company X2, and some critical information will be modified.

The dairy industry is composed of a numerous of countries and companies with unique production practices and consumer markets. In rural areas, dairy industry is essential for economic development and sustainable communities. The production of milk on dairy farms and the processing of milk and other dairy products at dairy plants make up the dairy industry. Dairy products include wide variety of different consumable goods such as cheese, butter, yoghurt, milk, cream, ice-cream, etc. Dairy industry creates food products that form a regular part of many people's diets. It is also a huge employer in many parts of the world. (Fao.org, 2003)

The modern dairy industry is highly advanced technologically. With new technologies, the number of farms has decreased, but the number of cows in one farm has increased, creating bigger, more efficient dairy farms. New technologies allow the dairy businesses to collect milk more efficiently and maintain the high quality of milk, ensuring the taste and safety of the product. New technologies have also opened totally new possibilities to process milk, allowing new dairy products to enter the market. (Missouri Education, 2011)

Dairy is very fast paced industry. The products are easily perishable and require low temperatures all the way from production to the end customer. The main rule of production plant placements is that the products with short shelf life, such as yoghurts, creams and milk, tend to be located close to urban centres, near consumer markets. The distribution to retail stores often takes place directly from the production plants. Longer shelf life products, such as butter, cheese or milk powders are often spread around rural areas, close to the milk supply. The picking and warehousing of longer shelf life products is often centralised into one or more distribution centres from where they are sent to the retail stores and consumers. (Shackford, 2012)

1.1 Case company introduction

Company X1 is a global dairy business with over 10 subsidiaries (Company X2 being one of these) around the world. It is exporting its products close to 100 countries worldwide. The Company X is owned by multiple dairy co-operatives, each owning a share of the company. The company has over dozen production facilities producing more than 1000 different products, and multiple distribution centres which distribute these products to customers around the world. The company has multiple operations including functions such as production, logistics, sales, marketing, etc. The company is highly innovative, creating totally new, unforeseen products out of milk. This innovativeness is one of their competitive advantages, giving the company competitive edge against its competitors. The company has multiple worldwide known dairy brands. (Company X, 2016)

Currently, Company X1 employs almost 5000 employees worldwide, with close to 1000 employees working abroad. Generated sales revenue has been fluctuating between 1.5 billion to 2.5 billion euros over the years. The company focuses on both domestic and foreign markets, and currently over 30% of the total revenue comes from subsidiaries. Company collects over 80% of all the milk produced in their domestic market, and over 30000 people are involved in the whole chain. The company is the market-leader in dairy products in their domestic market, and possess significant market share in foreign markets on different dairy product categories. (Company X, 2016)

1.2 Objectives and Research questions

The main objective of this research is to investigate the changes happening in the order fulfilment cycle if the order cut-off time is postponed. Order cut-off time is the deadline when an order must be delivered to the supplier. If the order arrives after the cut-off time, the order processing will be moved to the next day. The researcher of this thesis also wants to investigate how this change affects the customer. The scope of this thesis is solely on the export supply chain from country A to country B. The research is part of a bigger project within the case company, aiming to provide theoretical background, analyses and perspectives to the order fulfilment cycle development for decision-makers.

The research questions for this study are:

What effects will there be to the order fulfilment cycle if the order cut-off time is postponed?

- a. What sort of operational adjustments are required?**
- b. How will the customer interface be affected by this change?**
- c. How will the supply chain costs change?**

To answer these questions properly theory related to supply chain in dairy industry and supply chain development is studied and analysed first. Theoretical framework aims to provide information about supply chain and order fulfilment, and tries to find knowledge about reasons, costs, benefits and challenges affecting the order fulfilment development of the case company. The research aims to help the case company in their decision-making of whether to implement this change or not.

1.3 Methodology

The research methodology aims to provide the optimal research approach for the thesis. A research methodology can be defined as *“...the actions to be taken to investigate a research problem and the rationale for the application of specific procedures or techniques to identify, select, process and analyse information applied to understanding the problem, thereby, allowing the reader to critically evaluate a study’s overall validity and reliability.”* (Kallet, 2004)

Research methods are often divided into quantitative and qualitative research. (Andale, 2016) For the purpose of this thesis both methods are used. Main focus is on qualitative research, but as both methods will be utilised, the multi-method research study is the most appropriate. By using multi-method research study methodology, the research aims to increase the overall understanding of the characteristics and meanings of a research topic, but also describe and interpret the case statistically with numbers. (University of Jyväskylä, 2010)

The case study strategy was utilised in order to create comprehensive research. In this research, with help of a case study, the dynamics, processes and structure of the research topic was explored.

1.3.1 Data collection methods

The data collected for research can be divided into two categories, primary and secondary data. Primary data is data that is nearest to the truth as it is collected by the researcher itself by using surveys, interviews and direct observations. The primary data is advantageous as the researchers are collecting information for the specific purpose of the study. On the other hand, secondary data may be described as any data which is obtained through documented data from articles, pictures, books and other forms of publications. Data can be in two forms based on their characteristics. Data that is statistically presented is called quantitative and data that is presented by words (i.e. theories, opinions, ideas, etc.) is called qualitative data. (University of Jyväskylä, 2010)

Both sorts of data were required in order to create comprehensive case study. Primary data collection for this research was done by surveys, observations, interviews and documentation. Secondary data was collected from different forms of literature such as articles, books, and journals. Secondary data was used to create the theoretical background to support the analysis. One of the challenges of secondary data research was the limited availability of information about order fulfilment in dairy industry and order fulfilment development in exporting business.

As mentioned above the primary data collection methods used for this research were surveys, observations, meetings and documentation in the case company. The aim of the survey was to bring insights to the research from the key members of the order fulfilment cycle in order to deepen the knowledge of different tasks, and how the order fulfilment change may affect their tasks. Observations were done within the organisation to gain knowledge about the daily order fulfilment cycle and its phases. Documentation data was collected from the organisation's ERP system and already existing documents. The primary data obtained from the organisation provided excellent and reliable support for the research. As the research is part of a bigger project within the case company, these data collection events were related to this project and were not solely related to this research. Some of the main collection events are described in table 1.

Table 1. Main data collection events.

Date	Type of data	Members involved	Topics
3.10.2016	Meeting	Planners of different production facilities + sales planners (~25 participants)	Discussion about possible order fulfilment cycle changes
4.10.2016	Meeting	Planners of different production facilities + sales planners (~25 participants)	Discussion about possible order fulfilment cycle changes
7.10.2016	Survey	All planners & their superiors + warehouse shift-leaders (~40 participants) involved in the daily order fulfilment cycle.	Opinions about shorter order fulfilment cycle 1 / 2
18.10. – 29.11.2016	Observation and Documentation	All planners + warehouse shift-leaders involved in the daily order fulfilment cycle. (~35 participants)	6 week simulation of a shorter order fulfilment cycle
20.12.2016	Survey	All planners & their superiors + warehouse shift-leaders (~40 participants) involved in the daily order fulfilment cycle.	Opinions about shorter order fulfilment cycle 2 / 2
17.1.2017	Meeting	Terminal manager + logistics manager	Analysing effects of a shorter order fulfilment cycle

1.3.2 Data analysis

Data analysis followed the data collection process. The aim was to provide solid and sufficient argument for a case study. The analysis was done to investigate if the ways of the research were justifiable. A profound analysis considered also whether all the aspects of the study were covered.

The purpose of the data analysis was to understand all the data collected and how these were related to the research. The data collected from the empirical research of a case study was analysed and compared to the current state of the order fulfilment cycle, pointing out benefits, costs, challenges and development ideas.

The case Company X2 was running 6-week simulation of a shorter order fulfilment cycle for one of their biggest customers. The results of the simulation were analysed by the thesis researcher on multiple levels. This simulation played a big role in data collection and analysis. The goal was to analyse the results of shifting all the customers into the same cycle time by postponing their order cut-off time.

2 Supply chain in dairy industry

Supply chain (SC) is often defined as “A network of connected and interdependent organisations mutually and co-operatively working together to control, manage and improve the flow of materials and information from suppliers to end users.” On the other hand, supply chain management (SCM) can be defined as “The management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole.” (Christopher, 2016) Therefore, it can be argued that the point of supply chain management is upon the management of relationships to achieve a more profitable result for all the parties involved in this chain.

2.1 Supply chain in dairy industry

Supply chain in dairy industry starts from raw milk production and ends to a consumer receiving the final product. The starting and ending points are always the same, but the phases between them vary depending on the size of the company, the final product, scope of the distribution network, parties involved, information available, etc.



Figure 1. Milk Supply Chain (Rodríguez-Enríquez, 2014).

Figure 1 demonstrates the very basic supply chain in the dairy industry starting from the farm and ending to consumer buying the dairy product. The first phase known as

raw milk production starts the whole “cold chain”. Milk typically moves from the cows via pipes connected to the cooling storage tanks located in the farm. The milk is kept in these cooling storages (temperature in the tanks are often 3-5 Celsius) for no more than 48 hours. Dairy company collects the milk with tanker trucks and transports the milk to a dairy processor. Here the milk is tested to ensure the quality of the milk. Any milk batch that fails these tests will be disposed. After tests, the milk is transferred to the final production line. It may be homogenized, pasteurized to produce consumer milk, or even used as a raw material for cheese, yoghurt, cream, etc. (Kroll, 2015)

When the final product is completed, it is packed and shipped to retailers. It may go straight from dairy to retailers and to store shelf where consumers can buy fresh milk. Depending on the complexity of the supply chain, the final product may be transported between warehouses and terminals before being delivered to the final retailer. Often the basic milk is on store shelves within two days after it leaves the farm. Some dairy products, such as cheese, take longer to produce and often go through more steps before ending to the final retailer. (Kroll, 2015)

2.2 Key planning processes within the chain

Supply chain planning (SCP) is the forward-looking process of coordinating resources to optimise material flow from the supplier to customer. It aims to balance supply and demand by providing precise knowledge about the supply chain and future predictions, ensuring the delivery of goods, services and information from the supplier to the customer. SCP covers many aspects of a company’s overall supply chain, such as sales planning, forecasting, production planning, production scheduling, distribution planning, raw material planning, etc. (Gartner, 2015)

Dairy supply chain is certainly more complicated than figure 1 presents. There are multiple essential planning phases left out from the figure. These planning phases aim to predict the future and make the supply chain more effective for both, the milk producer and for the customer. By being able to predict the future supply and demand, a dairy business is able to efficiently allocate their resources to processes which require the most attention and provide the best possible value for themselves and their customers.

When we introduce more factors such as sales, sales planning, distribution or production planning into the dairy supply chain, the figure gets more complicated. Appendix 1

demonstrates broader approach to dairy supply chain and some of the important phases, which we will have a deeper look during the following chapters.

2.3 Sales planning and forecasting

Sales planning (SP) and forecasting must be tied to the whole supply chain. When it is integrated to other aspects of the supply chain, the supply chain is able to create better value for itself and for its customers. In fast paced supply chains, sales plans and forecasts play even bigger role than in slow paced chains. For example, in e-commerce business the goods are often already in stock when orders come in, but in cargo ship building industry, the ships are built against orders. If the SP fails in fast paced chains, the business will end up with lost sales or with a huge stock. If the forecast has been too low and too few products have been produced, there will be no stock to fulfil orders and customer will go to competitor to get the product. Whereas, if the forecast has been too high and too much has been produced, the business will end up with huge stock. Business might not be able to sell all extra products in time or their resources might be tied up in this stock. Therefore, they are not able to use their resources more efficiently. (Stadtler and Kigler, 2015)

In dairy business sales planning and forecasting plays a huge role as the sales guides the production and the whole supply chain. Without efficient sales forecasting business will not be able to produce efficiently and match the demand. Dairy products are also more troublesome to forecast as they get easily spoiled. If the sales forecast is too high and too much is produced, it is possible that everything cannot be sold in time and this in turn causes losses as these spoiled products must be disposed. (Optimity Software, 2016)

2.4 Production planning

To create effective and cost-efficient supply chain, it is essential to integrate the production planning (PP) to other supply chain processes. PP and production controlling supports the whole supply chain by producing the right goods at the right time, thus allowing the supply chain to fulfil the customer orders.

There are few fundamental problems which production planning must address before producing anything:

- Production capacity
- Low productivity
- Production prioritizing
- Production quality
- Current inventory and inventory management
- Sales forecast and actual demand
- Resource utilization
- Possible downtimes of machines

In dairy industry, it is important to produce as per demand, but still be efficient by keeping in mind the production capacity and low productivity issues. Production must pay close attention to production amounts and continuously monitor and control the operation. The machinery requires a lot of maintenance so that the production quality is according to specifications. Machinery must be washed after switching to another product, so that the product quality will not suffer. Also, it is very important to follow the whole process closely to prevent anything unfamiliar disrupting the production. (Entrup, 2005)

When production planning is done correctly, it benefits the whole supply chain and the organization, but also the customers as they will receive what they ordered and are able to avoid shortages in their stores.

2.5 Distribution planning

Distribution planning (DP) is a systematic approach to ensure that the process encompassing the delivery of goods to different warehouses and distribution centres is done properly. Distribution plan is used to determine which goods need to be supplied in what quantity at what location in the desired time. DP is done in close collaboration with sales planners and production planners, as the planners must keep in mind the demand trends, seasonal variations, production times, current stock, possible campaigns and the anticipated demand. (MBA Skool, 2008)

In dairy industry, the output of the distribution planning process consists of the aggregate channel of inventories, shipments already in progress, warehousing, unvendible products (dates of the products have passed the date promise for customer), transporting capacities, quarantine time of goods before they are sellable (i.e. butter is produced in warm temperature and must be cooled down to become firm. Also, the law prohibits the transportation of any dairy goods which are over +8 Celsius). (ROSS, 2016)

When distribution planning is done correctly, it increases efficiency of the whole supply chain. All shortages of goods are minimized as the demand is accounted for during the time of distribution. Also, the cost of transportation and warehousing can be reduced considerably as the planners know what goods are needed and when. Therefore, the inventory can be kept under control in the desired level, and the supply chain can utilize the resources better as there is no extra money tied up in the inventory. (ROSS, 2016)

2.6 Order fulfilment cycle

Order fulfilment cycle (OFC) comprises the process in receiving, processing and delivering a customer order. It refers to all the steps companies must take from the moment they receive an order until the goods land in customers' hands. There are many types of order fulfilment options such as Engineer-to-Order where the product is completely build and designed to customer specifications, or Assemble-to-Order where the product is built to customer specifications from an inventory of existing materials, and finally to Make-to-Stock (MTS) where the product is built against a sales forecast, and sold to the customer from an inventory of finished goods. If the product is in digital form, the option might even be Digital Copy where products are digital assets and copies are created on-demand, downloaded by the customer and saved on their storage devices. (Orrigo, 2015)

2.6.1 Order fulfilment cycle time

Based on Meller (2015) Order fulfilment cycle time (OFCT) can be defined as the amount of time from customer leaving the sales order to the customer receiving the product he ordered. It is an important factor for customers as it represents the total "time of waiting".

The order fulfilment cycle consists of three different components each requiring different amount of time. These components are:

- **Order Reception Window:** The time window in which orders are received between two consecutive order cut-off times. For example, the order cut-off time could be at 12:00 am each weekday. If an order is received before 12 am, the order processing will start right after 12 am. If an order is received after 12 am, the order is moved to the next day and order processing will start the next day after 12 am.
- **Order Processing Window:** The time it takes to process an order in the warehouse or distribution centre. This process includes planning, picking, packing, labelling, and loading it on a truck for shipment to the customer. The order must be processed so that it will be completed by the transportation cut-off time. If the order is not completed by the transportation cut-off time, the truck will not leave in scheduled time which means that the order delivery will be late, or that the truck might leave without the order, which also means that the order delivery will be late.
- **Transportation Window:** The time it takes to transport the order to the customer once it has been shipped from the warehouse or distribution centre.

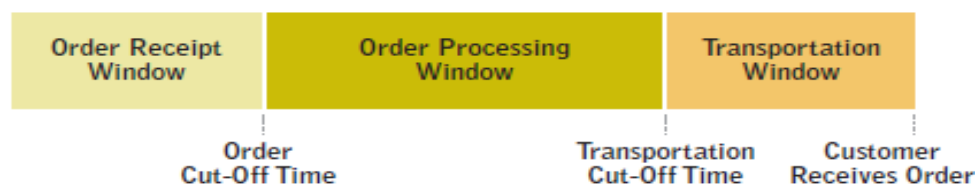


Figure 2. Order Fulfilment Cycle Time (Meller, 2015).

Figure 2 demonstrates the ordinary order fulfilment cycle. The order fulfilment cycle time often depends on the complexity of the process. Basic guideline is that the more complex the process is, the more time it takes to complete.

2.6.2 Challenges within the order fulfilment cycle

Businesses face challenges throughout the order fulfilment cycle. These include challenges related to sales planning, lead times, stock management, logistical planning, supply chain optimization and information systems. Some of these challenges are discussed next.

Sales planning (SP) involves forecasting and knowing in advance what the demand will look like. SP also involves efforts to create demand by marketing or promotion tools. When SP does not go as planned, the result is running out of stock on some products or overstocking some products. (Meller, 2015)

Stock management and sales planning often go hand in hand. Stock management focuses on keeping the stock of different products at the wanted level. Stock management and sales planning need to communicate with each other in real time to prevent problems. When stock management and sales planning do not meet, the result is going to be the same as above: running out of stock or overstocking. (Orrigo, 2015)

Supply chain optimization, lead times and logistical planning focuses on distribution and production, and how quickly is the supply chain able to replenish the stock on needed goods. This requires planning and communication within the supply chain. Production must be aware what needs to be produced and when, and distribution needs to know when the goods must be transported from the production to the warehouse or distribution centre. When there is lack of communication within the supply chain, the replenishing of stock is likely to fail. Production can produce products in wrong order or distribution could transport wrong goods. This again will cause out of stock situations and the customers' orders cannot be fully fulfilled in time. (Meller, 2015)

Also, Information systems create challenges within the order fulfilment cycle. Even though information systems are often working as they should, the users using them are not. Human errors happen, orders might not go through within the system as intended, orders are not visible, etc. Also, when systems are communicating with each other (i.e. ERP system of the supplier is communicating with the customer's ERP system or the supplier's ERP system is communicating with their own warehousing system) there might be problems related to translating the information correctly. All these potential

system problems require daily monitoring to avoid any misinformation. When orders are not showing correctly, this will affect the whole supply chain and mistakes can happen in any part of the chain. (Orrigo, 2015)

2.6.3 Order fulfilment in dairy industry

As mentioned in the start of chapter 2.6, there are different types of order fulfilment options such as Engineer-to-Order or Assemble-to-Order. However, without expectation in dairy industry (and in other grocery sectors) the order fulfilment option used is Make-to-Stock. The customers (i.e. retail stores or HoReCa) of dairy companies order ready products from the dairy business to sell to their own customers (often consumers). (ROSS, 2016)

Based on Bulger (2013), the whole order fulfilment process includes many phases and varies depending on the process. Each organization modifies their order fulfilment process to match their process. However, the basic order fulfilment process is the following:

- The customers' order is received, either on the phone, via email or through information systems.
- Order is entered into the ERP system by hand. If the order is received through integrated information systems, the order is automatically entered to organisations ERP system through EDI.
- Customer gets a notification that the order has been received.
- Orders are processed and the inventory availability check is done.
- Orders are modified if needed (perhaps the whole order cannot be delivered because of stock shortage).
- Order confirmation is sent to the customer.
- Distribution planners perform route planning and analyse what is the best way to deliver this order to the customer.
- Order is sent to the warehouse.
- Order is picked.
- The picked products are properly packed for shipping and labeled with customers' information.

- The driver delivering the order loads the products and collects any necessary documents from the warehouse (such as bill of lading, shipping notes, etc.)
- Order is shipped.
- Order arrives.
- Customer makes a complaint if any deviation appears on the order.
- Possible returns are done.
- Payment for goods / services / delivery.

The order fulfilment cycle time in dairy industry can vary depending on the location of the customer and the order itself, but often the order will reach the final destination within 24, 48 or 72 hours after customer making the order. When order fulfilment is smooth, flexible and efficient, the customers will be satisfied and the whole organization benefits.

3 Supply chain development

In this chapter, the thesis will be focusing on issues how to develop supply chain and order fulfilment process. Improving performance throughout supply chain is important and something companies should always be focusing on. By developing supply chain and order fulfilment, companies may be able to cut daily operating costs and increase their gross profit margin, strengthen current market position or gain new customers by offering better services. Before considering the points how supply chain and order fulfilment process can be developed, one should have a look at the whole value chain.

3.1 Value chain

To develop business, it is necessary to cover activities as a process composed of different phases. Professor Michael Porter (2008) divides these process phases into two categories: primary activities and support activities. Instead of looking at each department or accounting cost types, Porter's model focuses on systems, and how inputs are changed into outputs purchased by consumers. These chains of activities are common to all businesses, and the model can be utilised in most occasions. The figure 3 shows Porter's Generic Value Chain. (Porter, 2008)

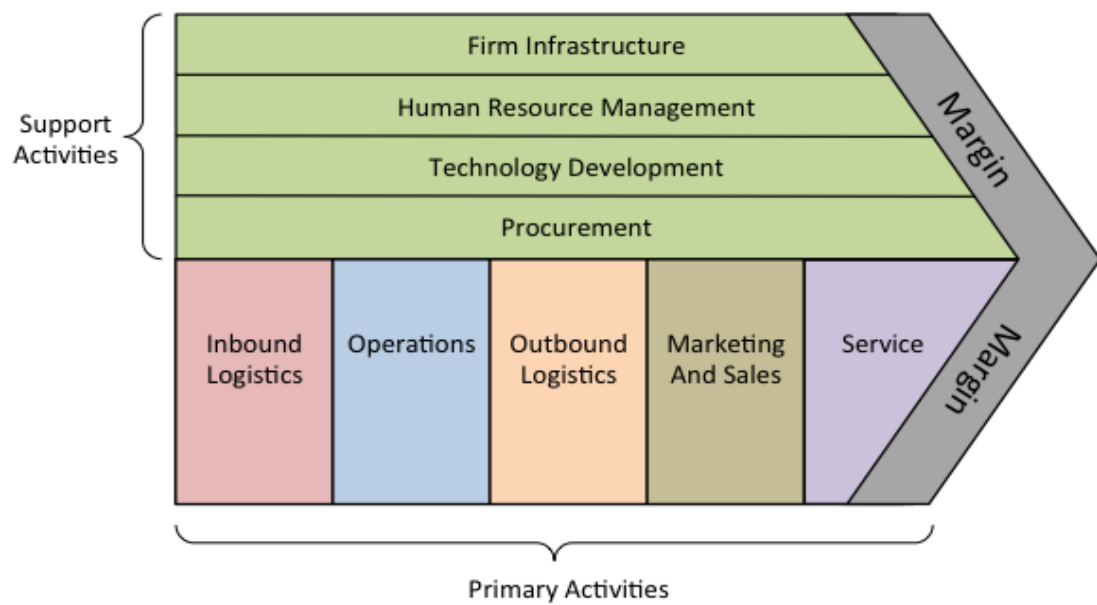


Figure 3. Porter's Value Chain (Porter, 2008).

Based on Porter (2008), the primary activities relate all directly to the physical production, sale, maintenance and support of a product or service. These primary activities are:

- **Inbound Logistics** – Processes related to receiving, storing, and distributing inputs internationally (i.e. Transportation of milk from farm to dairy). Relationships with businesses suppliers are a key factor in generating value here.
- **Operations** – The actual creation of a final product or service which is then sold to customer. It is the phase where inputs are transformed to outputs (i.e. Pasteurising and creating lactose-free milk from raw milk, and finally packing it to unit which can be sold to customer). Businesses operational systems are creating value in this area.
- **Outbound Logistics** – These activities include delivering the finalised product or service to the customer. This phase includes things like collection, storing, distribution and order processing (i.e. receiving customer order, picking and collecting the order and distributing in onwards to the customer). The outbound logistics may be done internally by a company, or these may also be outsourced to another party.
- **Marketing and Sales** – Processes which aim to persuade businesses customers to purchase from them instead of their competitors (i.e. advertising, sales campaigns, etc.). The benefits offered to the customer, and how well these are communicated onwards, are the sources of value here.

- **Service** – The final primary activities are related to maintaining the value of a product or service to businesses customers, once it has been purchased (i.e. customer service, post-purchase counselling, etc.)

The supporting activities focus on assisting the primary activities. Each of these supporting activities can be paired with any primary activity.

- **Firm infrastructure** – These are a company's support systems, and functions which allow it to maintain daily operations. Firm infrastructures such as accounting, legal, administrative, and general management are necessary supporting activities which can create positive value.
- **Human resource management (HRM)** – HRM includes activities related to recruiting, hiring, training, motivating, retaining, and rewarding its workers. For many organisations, human resources can be seen as the most important source of value. Therefore, it is important for businesses to maintain and continually develop their HR practices.
- **Technological development** – These are activities which relate to managing and processing information, as well as protecting a company's knowledge base. To generate most value out of technological activities, a business must be able to minimise technological costs and stay current with the most necessary technological advances as well as maintain technical excellence.
- **Procurement** – This supporting activity includes finding and purchasing the resources it needs to operate. Procurement activity includes finding vendors and negotiating prices.

Company's staff is important component of the process. For the value chain to work smoothly, staff and stakeholders must maintain agreed standards and perform accordingly. The point of value chain analysis is to ensure that each member of the staff is aware how their tasks affect and how they can create additional value for the organisation. When the process is successfully executed, the result is shown as a customer purchasing the product or service the company is offering. (Porter, 2008)

Therefore, the success of a company highly relies on company's ability to create additional value for itself. Company can create competitive advantage if they are able to perform value chain process more cost efficiently or more effectively than its competitor. Anyhow, the final decision and evaluation is done by the customer. If the customer

is not the end consumer, the customer will attempt to perform its own value activities better than his competitors. It is important that the company does not only need to recognise its own customers, but also the customers' customers. Thus, to develop current business activities and value chain effectively, the main baseline should be customer oriented approach. (Porter, 2008)

Successful process achieves organisations aims in many different levels (objectives/targets, values, strategy, etc.). To achieve success, activities must be given targets and these targets must be measured. Activities should be designed in a way which eliminates all the unnecessary phases, without losing the sight of a simple general view. Each activity should have its own area of responsibility, which ensures the overall quality of the process. (Porter, 2008)

The activities also require the support of data systems, which combine and connect the whole process together. The following chapter will cover the data management, and how it is necessary for supply chain development.

3.2 Business intelligence

Business intelligence (BI) is the set of machines, strategies, systems, programs, files, the users of the systems, etc. It is the combination of these to facilitate planning, control, coordination, and decision making in an organisation. Business intelligence is about modifying and producing data, moving this data from one place to another, shaping it from one form to another or distributing it from a worker (or a system) to another. The goal of information systems is to produce data for organisation activities and management. (Pratt, 2017)

Business intelligence aims to predict the future and react to it. It is designed to parse the data into a structural format, and bringing employees empirical experiences and know-how for everyone's use. For the organisation to succeed, it requires efficient business intelligence which will help the organisation to react to competitors' actions and foresee the needs of customers and stakeholders. It is important to note that the knowledge and information only becomes valuable, once this knowledge has been modified to a structural form. After modification, the knowledge will be easier to refine and it will become extremely helpful tool in decision-making. For the organisation to be able to gain the best possible knowledge and really utilise business intelligence for its

benefits, it needs to pay attention and analyse each department, as each department conceals valuable information. The empirical experience and know-how of the staff is often very valuable for organisation, but quite often it is hard to be obtained and capitalised for the use of the whole business. (Pratt, 2017)

Organisations work is often based around businesses information systems. When developing a process, the organisation often runs into problems with the complexity and stiffness of their information systems. Introduction of new developments can be delayed if the information systems are not compatible with the new process or simply do not satisfy the needs of the organisation. As the technology advances and the information systems become more capable of dealing with complex processes, humans are not that needed as middleman between the systems. Anyhow there are still quite many processes information systems cannot deal with, and this requires organisations to hire staff to act as “translators” between the systems (for example order sent via email to the company requires human actions to enter this order by hand into organisations information systems). (Thakur, 2015)

In daily order fulfilment cycle, incapable information system may cause a lot of work for both seller and buyer. These results directly in additional costs for the organisation, but even bigger problem may be the process being slowed down and the time delays it occasionally causes. Also, the manual work done by a staff member increases the number of mistakes as the data is entered by hand. Therefore, it is important to minimise additional phases within the daily order fulfilment cycle, and information about orders, invoicing, customer/order modifications, etc. should be possible to shift directly from one system to another. (Efulfillmentservice.com, 2010)

Investments into more complex and more capable information systems can help the organisation to cut down these phases, but the problem might still exist if their customer does not have a similar system in use.

3.3 Developing order fulfilment cycle

The need to develop order fulfilment cycle (OFC) often starts from customers' request. Customers are increasingly demanding short cycle times and customers consider short order fulfilment cycle time as a very important factor when choosing suppliers. Leaving order later and receiving order faster is becoming more important all the time. If busi-

nesses are able to combine a great product with fast deliveries and late order cut-off times, they will gain competitive edge over their competitors. This chapter will be focusing on different ways to achieve faster OFC and what will be the costs and benefits of it. (Meller, 2015)

3.3.1 Ways to achieve faster order fulfilment cycle

As mentioned by Meller (2015) the order fulfilment cycle consists of three components: the order receipt window, the order processing window and the transportation window. Faster fulfilment is a trade-off between these three components. To achieve faster order fulfilment cycle, time used to complete one or more of these windows must be reduced.

There are multiple ways to expedite the cycle and here are few of them.

1. **Integrating existing processes to shrink the time used to process an order.** To quickly fulfil an order, business requires visibility within their supply chain. When key members involved in the order fulfilment cycle are able to see sales plans, existing sales, current inventory, distribution plans, etc. all in one place, it makes the fulfilment smoother. They will be able to see instantly what sort of actions need to be taken so that the order can be fully processed. Business also wants to have their sales order management and ERP system fully linked so that there is no need for a middleman to manually enter the orders by hand. Also, logistical systems that handle warehousing processes such as picking, packing, labelling and shipping should be linked with ERP system and order management. (Meller, 2015)
2. **Accurate sales planning:** It is easier to achieve faster order fulfilment cycle when a sales planning is on the point. With accurate sales planning, supply chain is able to produce correct products and distribute those into correct locations. When the customer orders finally come in, business will be prepared to process these orders right away, as the products needed are already in the correct location. Accurate sales planning and forecasting is often challenging, but there are ways to ease this. Information, knowledge and transparency are the keys to success. To achieve a well-constructed forecast, business will require the following:

- a. Broad historic sales data,
- b. Knowledge about seasonal trends,
- c. Knowledge about customer behaviour,
- d. Assumption about sales progress,
- e. Knowledge about current inventory (in retail-business it is also important to be aware of customers' current inventory)
- f. Precise information about campaigns and promotions, and the expected impact of these (Orrigo, 2015)

3. **Automate processes to increase productivity:** Automation is a great tool and machines have proven to be extremely efficient in order processing, but they might not always be required for automating processes. Simple and inexpensive scanners for example can help workers a lot and expedite the process. When warehouse is able to scan the goods as they come and go, it is much faster than manually entering information to warehousing systems. Other automation processes like conveyors, voice controlled picking system or picking lights to improve the productivity of pickers have also proven to be effective. (Orrigo, 2015)

4. **Classify inventory to ensure rapid handling:** Company wants to keep an eye on the stock keeping unit (SKU) placement inside their warehouse. Fast moving high volume SKUs should be easily available in multiple locations and always rapidly replenished to ensure smooth order processing and continuous picking. Slowly moving low volume SKUs do not need as much attention, as there are fewer "touches" directed to these. Also, it is important that different SKUs must be logically positioned within the shelves, so that the picking route makes sense. When picker is collecting an order, it should be done correctly right from the start. This means the big and heavy items should be picked first, so that they will be positioned on the bottom of a picking unit, and smaller, easily breaking items should be picked last so they will end up on top. (Meller, 2015)

3.3.2 Costs of achieving faster order fulfilment cycle

Faster fulfilment may come at a cost. Investments in operations, distribution, or data systems may be required to achieve faster fulfilment. Company might need to rethink their network and transportation strategy; where warehouses or distribution centres are

located and how should the stock be allocated among these locations to expedite the delivery to the customers and reduce transportation costs. Optimising deliveries to customers and increasing truck arsenal to reach customers faster as there will be less orders to deliver per route. (Orrigo, 2015)

Current distribution centres and warehouses may need big adjustments. If the current facility is designed to operate with longer OFC, there may be significant changes needed to get the process done in shorter time. Processes need to be parallelized and orders combined to expedite the overall processing window. Even physical changes may be needed if the current picking area (shelves), unloading area, or loading areas are slowing the process down. (Meller, 2015)

3.3.3 Benefits of a faster order fulfilment cycle

Although there are many costs related to faster fulfilment, there are also numerous of benefits. When a company is mapping out the possibility for faster order fulfilment cycle, they might find out that significant investments will be needed to achieve this. However, there are plenty of benefits order fulfilment change will bring. Some of these benefits are explained next.

1. **Later order cut-off time increases sales:** When a customer is able to leave the order as late as 5 p.m. in the evening, but still get the order the next day, they will be very satisfied. If the order cut-off time of the company is later than their competitor's, but they still deliver the order at the same time, they will gain competitive edge. Late cut-off time is highly valued by customers as customers tend to consider their order as long as possible before placing it or the realisation of a need has just emerged. Also, if the customer is a retailer and will be selling the product onwards to their own customers, fast fulfilment and late order cut-off time will help their own procurement and sales planning. Forecasting will be easier and stock levels can be kept lower when the goods are easily available. When company's competitors are facing delivery problems (i.e. production problems, inventory problems, strikes, etc.) and cannot supply the wanted goods to the customer, the customer might turn to the company as they can get the goods fast. This again will increase the sales of a company. (Meller, 2015)

2. **Faster fulfilment strengthens companies' market position:** If the company is able to provide order fulfilment cycle in a way that satisfies the customer, it will create value for the customer. When a satisfactory OFC is combined with good product(s) and/or service(s), company's market position will be strong. Fast fulfilment will help the company to retain their current customers, and even open doors for new customers who are speed sensitive. Faster order processing and later order cut-off times also gives more time for the company to transport the goods. By using more time on transportation, company will be able to realise even larger geographic reach. (Muzumdar and Zinzuwadia, 2015)

3. **Faster fulfilment reduces inventory:** When company is able to process the orders quickly, they do not need to keep high levels of inventory as a safety stock. Goods needed for the order will stay shorter time in their distribution centre since the order processing requires less time. This again will reduce the total inventory and create significant savings within the supply chain. Company is able to utilise the space better as there is no need to store the goods in shelves like before. This free space can be used for other needs or even totally new products. (Meller, 2015)

4. **More accurate sales planning:** When company is selling goods to other retailers and offering fast fulfilment, they will be able to analyse their customers better. When customers do not need to forecast as much, their orders will likely be more formulaic. This helps companies to analyse better how their customers behave. By knowing how the customers behave, company is able to create more accurate sales plans as they have better understanding of how the orders are likely to be each weekday. Sales planners are able to find specific trends about customer behaviour. (Muzumdar and Zinzuwadia, 2015)

The decision-makers need to analyse closely both costs and benefits of achieving faster order fulfilment cycle. The benefits do not often come right away and it might require years before the investment really starts paying off. Decision-makers need to look at the possibility broadly as the justification for the investment is often found outside the company. Many benefits such as strengthening market position and/or obtaining new customers cannot be evaluated in revenue beforehand. (Orrigo, 2015)

3.4 Cost-efficiency in supply chain

Cost-efficiency can be described as an act of saving money or improving an activity to perform in a better way with no additional costs. Each organisation aims to implement their supply chain in a way that is as cost-efficient as possible. There are many different processes within the supply chain such as manufacturing, warehousing, transportation, planning, etc. which can be optimised. Organisations of all sizes and across all industries can achieve significant savings by making their supply chain cost-efficient. (O'Byrne, 2011)

In this chapter the organisations' activities have been divided into two categories – those which do not create value for the customer and to those which do.

3.4.1 Minimising costs of non-value activities

To achieve significant savings, companies must know what process to look at to reduce costs. It is important to minimise costs of any “useless” activities which do not create additional value to the customer. In a supply chain, there are quite a few of these. (O'Byrne, 2011)

According to O'Byrne (2011) some examples of “useless” activities which do not create extra value for the customer are:

- Warehousing
- Shifting goods from one warehouse to another
- Inspection of received goods
- Delivery control
- Creating purchase orders by hand / in writing
- Inspection of invoices
- Fixing mistakes and filing a complaint
- Receiving sales orders and entering those into businesses' ERP system
- Inventory checks / taking an inventory

These activities are of course necessary in order to perform a successful process, but in the eyes of a customer, these activities do not create or increase the value of a product or service. Therefore, the time spent on the activities mentioned above should

be minimised. Also, other activities should be done in a way which does not require inspection or redoing. (O'Byrne, 2011)

O'Byrne (2011) mentions few ways to minimise time spent on these “useless” activities:

- Picking route optimisation in a warehouse
- Receiving an order from a customer in a way which does not require additional handling
- Creating helpful IT-programs to assist in delivery control, so that the warehouse staff does not need to go through each product in the loading area to ensure that everything is in place.

Good and close co-operation within the company between different departments, suppliers and sellers usually helps to optimise and minimise costs of these activities.

3.4.2 Improving value creating activities

Customer value is what the customer is looking for, and for this reason activities which create this value are extremely important in any supply chain. Basic activities like manufacturing, customer service and transportation cannot be ignored and these require daily attention in order to maintain set standards. Even though these activities are important and not necessarily those which supply chains want to cut costs from, it is still crucial to consider costs of these activities. A company does not want to reduce the quality of their product or service by cutting from these activities, but if they are able to achieve the same end results (customer value) with lower costs, this is something they should definitely look into. (Jorgenson, 2015)

Jorgenson (2015) points out some activities and ways in which they create customer value within the supply chain:

- Manufacturing / Production
 - Creation of the actual product or service which customer will receive.
 - Manufacturing can create additional value for the customer if the organisation produces a totally new product, modified version of the existing product or even new packaging based on customer needs.

- Sales and operations planning (S&OP)
 - Can provide customer with faster fulfilment, meaning that customer will receive the order quicker or can give their order later.
 - Good sales planning does not directly provide value to the customer but without good sales forecasts, the supply chain will more likely face fulfilment issues resulting in bad service level. This means that customer might not receive the goods it ordered on time.
 - S&OP also allows the customer to create campaigns for its own customers.
- Transportation
 - Transportation creates value to the customers because they are able to get their orders directly delivered to the location of their choosing.
 - When seller handles logistics and transportation, customer can focus directly on their own business and does not need to use human resources to handle these areas. Also, the seller has likely a better knowledge and know-how of the transportation regulations and safety issues related to his own goods.
- Customer service
 - Customer service can provide the customer with valuable information about the goods or services he has received.
 - If customer has any complaints or wants to return the goods he has bought, this is the channel to use. It allows the customer to get refunds on broken goods or completely replaced goods.

There are multiple ways to improve already existing activities, but all changes might not be necessary. When improving these activities, it should be kept in mind that the result must benefit both of the parties, the buyer and the seller. Jorgenson (2015) lists few scenarios which will help to decide whether the change should be implemented or not:

1. If the change will create additional value to the customer without extra costs for the organisation, it should be implemented. Even though an organisation might not benefit from it directly in profits or in revenue, it will strengthen their market position and placement against their competitors in the eyes of a customer.
2. If the change will create additional value for the customer and for the organisation, but will require investments, the return on investment (ROI) should be con-

sidered. If the ROI is positive, the change should be implemented, and if the return is negative, the change should be abandoned. All results cannot be measured directly in money, so factors like market position and image need to be considered as well

3. If the change creates additional value for the customer but will require investments from the organisation and will not result in any additional revenue, organisation should consider the opportunity cost between the current way of doing and the new option. If the new option seems to create sufficient amount of wanted value (i.e. strengthened market position) also for the organisation, the change should be deployed. Whereas if the change does not bring the wanted result for the organisation, the option should be abandoned, even though it might create additional value for the customer.

3.5 Quality costs in the supply chain

Quality costs often occur when a business improves their service or product quality to match the customers' needs. Lecklin (2006) mentions that there are two types of quality costs: The first one includes costs which occur when quality is being improved, and the second one occurs when current quality is not at the wanted level. These two types of quality costs are explained next.

1. Quality costs which occur when quality is being improved. This cost most likely is part of investment and development plan. Often quality costs like this can be recognised beforehand and can be the decisive part of decision making process. For example, a business might want to expedite their order fulfilment cycle to satisfy the customers' needs better. Or maybe the customer might want more environmental packaging material and to achieve this, the business must invest more into the packaging materials. These are both costs which originate from trying to achieve certain quality level.
2. Quality costs which occur when quality is not at the wanted level are also known as cost of poor quality. Cost of poor quality might be hard to recognise, pinpoint and fix. These are often costs which are not considered when a process is being developed. Costs of poor quality are most likely not included into decision making process, because if everything goes as planned, these costs

should not happen. For example, manufacturing performs critical error when creating the product, and therefore the product cannot be sold to the customer. This means that all the materials, resources and time used to create this product will be wasted, and the product must be disposed (which costs too). Also, the customer will still want the order he placed and if business does not have enough materials, time or any other resource to create this product, the sale will be missed (loss of revenue), their image in the customers' eyes has because of weakened service level and possible market share will be lost.

Olli Lecklin (2006) divides quality costs into even smaller groups, 1) External error costs, 2) Internal error costs, 3) Quality maintenance costs and 4) Bad quality prevention costs. Lecklin states that quality costs are usually not easy to spot, and monitoring these requires untraditional thinking and cost accounting. Quality costs can often be monitored by various process indicators (KPIs). Researchers have found that quality costs account for 10 to 30 percent of business's total revenue, making it one of the biggest expenses for an organisation. Lecklin's four groups are explained in more detail.

1. External error costs happen when the error or quality issue noticed by a customer gets fixed. In this case the quality control of a business has failed and the error has reached the end customer. These external errors are the most expensive and most dangerous to the business. Fixing an error which has already reached the customer will be more expensive than fixing it already at the place of manufacturing or place of dispatch. External errors will also damage the business's image. External error can be a picking error where customer receives totally different product than they ordered, or product quality error. In these cases, the supplier might have to deliver the correct replacement product as soon as possible and also retrieve the error product back. Fixing just this error causes a lot of additional unnecessary costs, such as transportation, replacing the goods, possible reclamation costs, spoilage of the error product, etc.
2. Internal error costs are spotted within the organisation and fixed before the error reaches the end customer. These costs can be caused by bad planning, staff errors or manufacturing errors. Internal error can be e.g. product quality spotted within the warehouse (broken or unsellable product) which will require replac-

ing, or warehouse staff picking the wrong goods which are spotted before dispatch to the customer and will require re-picking.

3. Quality maintenance costs include the maintenance to minimise and avoid these mistakes. Without quality maintenance, there will be a lot more errors causing additional costs. Maintenance is required to check on the final product and ensure the quality. Quality maintenance costs are caused when staff is assigned to check the final delivery (i.e. worker uses his time to check deliveries and therefore resources will be tied on quality maintenance, and not necessarily on creating additional value for the organisation) or when the production takes samples of each production batch (loss of goods and worker resources tied on checking the quality).
4. Bad quality prevention costs are caused when possible errors and quality issues are removed in advance. Activities such as planning, developing and training can be sources of these. Directing resources into these activities can reduce the time and money used on quality checks and maintenance, but still keep up the high quality standards. Bad quality prevention cost may be investment into improved quality maintenance tools (i.e. automatized delivery checking tools which reduces the time used on checking the delivery or Radio Frequency Identification (RFID) -tags on each pallet or product, to ensure that everything is correctly loaded). Therefore, improving and investing into these activities will pay back the value in reduced amount of errors.

3.5.1 Decreasing quality costs in supply chain

For the supply chain to manage its quality costs, the business will require monitoring systems which present these costs. When business wants to decrease a certain quality cost, the activity causing these costs, must be monitored. Process map can be utilised to evaluate different phases of an activity and their cost impacts. Two of the most common quality cost decreasing factors are reducing errors and speeding up the supply chain process-cycle. (Lecklin, 2006)

Reducing errors begins by discovering the activity which causes these errors and the source of the error. Then the activity must be investigated thoroughly and why these errors happen – is it always caused by the same source or are there more factors

causing the mistakes? After the investigations, the source needs to be addressed, find a way to improve and fix the current method / way of doing, or develop totally new method. After introducing the improved / new method, it should be monitored to see if the problem still exists. For example, picking errors causes a lot of unnecessary costs and harm for a business. These are often hard to deal with and will always be present if there are picking related activities. Picking error can be caused by a human mistake made by the picker or person filling the picking spots, person in manufacturing sticking wrong labels on the packages or pallets because of being in a rush, etc. Picking errors cannot be overlooked and actions to monitor and minimise these must be implemented. It might require investments on resources which minimise these errors, such as checking the customers' delivery load before dispatch or placing inspection screens showing numbers or codes at the picking locations which staff must consider before proceeding with the needed activity. (Lecklin, 2006)

Speeding up the supply chain process-cycle aims to minimise or remove the activities which do not create additional value to the customer as mentioned above in chapter 3.4.1. If there are some phases within the cycle which do not create any value for the customer, these should be minimised or even removed. If it is not necessary to move the goods from one place to another within the organisation, whether it is within the warehouse or even from warehouse to another, it should not be done. This just costs extra resources and does not create any value for the customer. Of course, some additional activities can be valuable for the business (i.e. checking customer deliveries before dispatch to avoid errors), but these activities should be measured precisely and determined whether they are valuable or not. When additional phases are reduced, the chance of errors and mistakes taking place reduces as well. For example, when the fast-moving goods arrive from production to the storage warehouse, they should not go through the whole storing process if it is not necessary. If the warehouse staff is able to pick the fast-moving goods directly from the receiving area, this should be done as it is more efficient than making the goods go through the whole warehousing process. This act will eliminate the storing phase, and no extra time will be used to first drive the goods to shelves and then right after pick the goods from these shelves. (Lecklin, 2006)

3.6 Key Performance Indicators

To improve the cost efficiency and value creating activities and to decrease quality costs, the supply chain activities must be measured with help of different indicators. Indicators are crucial part of the supply chain process management. They are used to measure the process and tell management how the organisation is performing in their critical success factors. If the process cannot be measured, it cannot be guided. If the process cannot be guided, it cannot be led or managed. By monitoring these indicators, management can increase performance drastically. Most of the process-indicators are statistical indicators, so these indicators can only be examined and covered after the process has reached its end. (Parmenter, 2015)

There are numerous of important key performance indicators (KPIs) in the supply chain. These indicators are often tracked periodically (weekly, monthly, quarterly, etc.) to see how the supply chain is performing and what activities should the supply chain focus on. The data needed to build these KPIs can often be acquired directly from the supply chain's own ERP-systems. (Fritsch, 2014)

USAID (2011) lists 8 important KPIs for any order fulfilment cycle:

- **Forecast Accuracy** – Forecast accuracy measures the percentage of difference between forecasted demand and actual demand. When forecasted demand and actual demand are same, the forecast accuracy will be 100%. When the forecasted demand is higher than actual demand, the accuracy is lower than 100%. This means that the product has been undersold and there is risk that the product needs to be disposed. Whereas, when the forecast is lower than actual demand, the forecast accuracy is higher than 100%. This means that the product has been oversold and there is a risk of stock out.
- **Inventory Turnover Rate** – Inventory turnover rate measures the number of inventory turnover for a certain product for a defined period of time. The higher the ratio, the lower the average inventory level and average holding costs. High inventory turnover rates can indicate insufficient stock levels, which could lead to stock outs. Low inventory turnover rates indicate that the product has possibly been overstocked or undersold.

- **Inventory Velocity** – Inventory velocity measures the average time a product remains in inventory. This indicator helps the warehouse to understand which products move fast and which slow. It also helps the supply chain to monitor how different products are doing. The lower the time, the less time these products spend in the warehouse.
- **Service Level** – Service level measures the fulfilment rate of a customer's order. When customer's order can be completely fulfilled, the service level will be 100%. If only 19 products out of 20 can be delivered, the service level will be 95%. The service level can be calculated in kilograms or in ordered items. Obviously the higher the rate is the better.
- **Spoilage / Destruction Costs** – Spoilage / destruction costs measure the amount of unvendible and broken goods. This indicator helps the supply chain understand if some product or process is not performing well. Spoilage costs can be calculated in euros or in kilograms.
- **Total inventory level** – Total Inventory level measures the average amount of products or pallets in the warehouse at each given time. This indicator helps the warehouse to understand how much of total storing capacity is used.
- **Total volume** – Total volume measures the volume development. It also measures distribution of volume between different products or product groups. This indicator helps the supply chain to understand how they are performing in terms of volume and helps the supply chain to allocate its resources to different days or processes.
- **Vehicle capacity utilisation** – Vehicle capacity utilisation measures the percentage of vehicle capacity used out of maximum availability by weight of volume. This indicator helps the supply chain to ensure the efficient use of vehicles and resources in general.

There are numerous of other important indicators which such as number of picking errors, total cost of delivery, capital tied to stock, total complaints filed by the customer, etc. Supply chain activities must be closely monitored and measured in order to perform the order fulfilment cycle efficiently. (USAID, 2011)

4 Result of a case study

The target of using a case study as a research method was to create better understanding of the order fulfilment cycle development in the case company. The researcher has been involved in the existing order fulfilment cycle and all its phases. The need to develop Company X2's exporting OFC from Company X1 located in Country A to Country B came directly from the customers of Company X2 in Country B. The goal of the thesis was to analyse the current state of the OFC and make research on how postponing of order cut-off time affects the daily order fulfilment. The aim was to disclose what operational adjustments are required to achieve this development, how the customer interface is affected and what sort of supply chain costs might emerge from this change. The researcher analyses also the benefits the customer will receive if the order fulfilment change is implemented.

The case study analyses first the current state of the order fulfilment cycle, and explains how the process is currently performed and describes some of the key processes. After the current state analysis, the study moves on to the results of data analysis. This in turn helps to define the required operational adjustments, costs and effects of the OFC development. The case study considers also the customer benefits emerging from the change. As there are multiple companies and facilities involved, figure 4 aims to clarify all the stakeholders involved in the case.

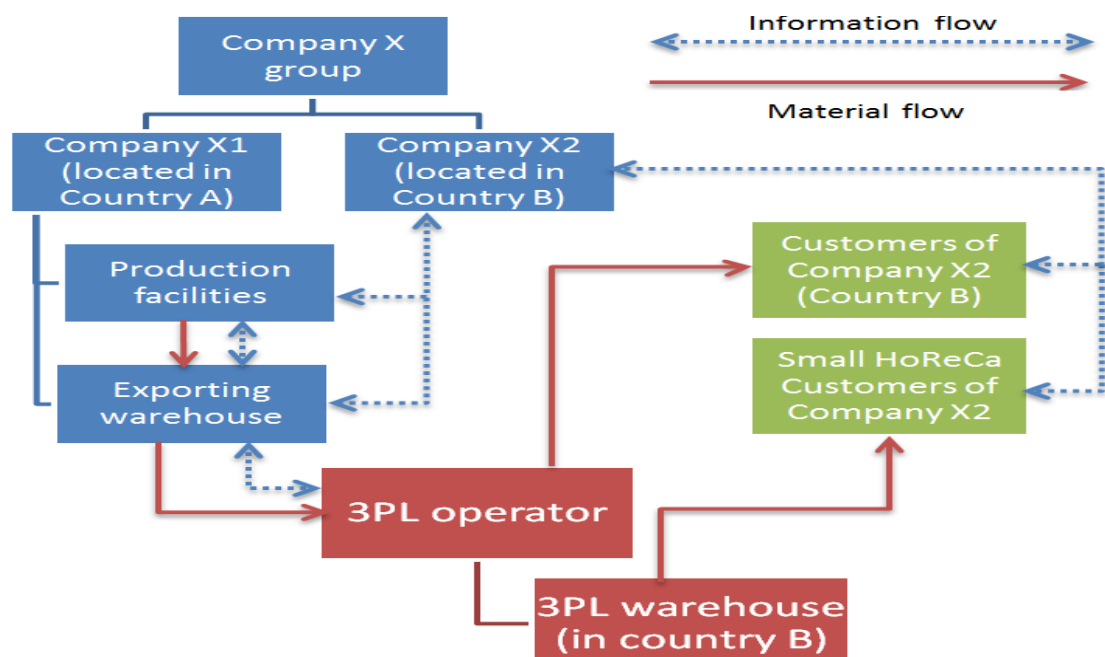


Figure 4. Stakeholders involved in the Company X2's Order Fulfilment Cycle.

4.1 Current state of the order fulfilment cycle

The current state of the export order fulfilment cycle in the case company is the following:

1. Order is received through EDI, e-mail or phone within two consecutive order cut-off times. In this case the order cut-off time is each weekday at 11:30.
2. The order is saved to the ERP system either by the system itself or by the customer coordinator of the company.
3. Planners execute availability check for the ordered products.
Planners inform sales about availability of goods and sales' creates order confirmation based on the availability. This is sent onwards to the customer as an order confirmation (order confirmation indicates what the customer has bought and what will he receive).
4. Planners perform transportation planning for the order.
Communication with 3PL operator about the need of trucks and route plans.
5. Planners create deliveries for picking and send them onwards to the warehouse.
6. Warehouse performs picking, packing and labelling for each pallet, and arrange the pallets near to assigned loading platforms.
When order is completely picked the customer will receive the delivery dispatch through EDI which states those goods that they will actually be receiving (often the delivery dispatch and order confirmation are identical, but there may be modifications)
7. Invoice is sent to the customer when the order is completely picked.
8. The 3PL operator arrives on appointed loading time and loads the ordered pallets into their truck.
9. 3PL operator distributes the order from the supplier's (case Company X1) warehouse in Country A to customer's distribution centre in Country B.
10. Customer receives ordered goods and inspects the received goods.
The customer files a complaint if the delivery dispatch and received goods do not match.
11. Customer checks out the invoice and the supplier receives payment.

The current order fulfilment cycle time is 3 days (72 hours). Depending on the geographical location of the customer's distribution centre, the delivery of the order may take 5 hours less (67h) or 10 hours more (82h). The smallest HoReCa clients (approx.

2% of total volume) are not delivered directly from the suppliers distribution centre. These deliveries will go through 3PL operator's own distribution warehouse in country B, and are delivered to the customers the next day of arriving to 3PL distribution warehouse taking up to 4 days (96 hours) in total before they reach the final destination. Table 2 presents the current order fulfilment cycle in days.

Table 2. Current Order Fulfilment Cycle in Days.

Customer places the order	Customers order departs from the warehouse in Country A	Customer receives the order in their distribution warehouse in Country B	HoReCa customer receives the order
Monday	Wednesday	Thursday	Friday
Tuesday	Thursday	Friday	Saturday
Wednesday	Saturday	Sunday	Monday
Thursday	Monday	Tuesday	Wednesday
Friday	Tuesday	Wednesday	Thursday

From the 11 order fulfilment steps mentioned above, first 5 are completed within the first 4 hours, step 6 and 7 are completed within the next 46 hours. Step 8 often takes 2-5 hours depending on the loading time. Steps 9-10 are completed within the following 15-30 hours (for small HoReCa clients step 9-10 takes up 44 hours). Final step (payment) is often done after the goods are received. Figure 5 demonstrates the timeline of different processes.

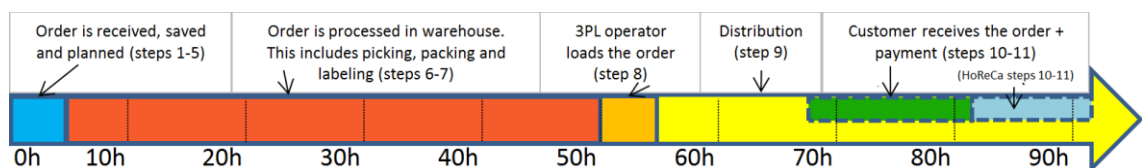


Figure 5. Current Timeline of the Order Fulfilment Cycle.

4.1.1 How key members are currently involved

When all the orders are in for the day, the customer coordinator of Company X2 will notify export planners of Company X1. Export planners will inform production facilities and their planners that the orders of the day are in. Both export planners and planners located in production facilities of Company X1 will start looking at the order quantities of

each SKU and communicate with each other about the availability of these. Production planners will also adjust the production plan according to the orders.

If some SKU has sold more than forecasted, it is possible that there will not be enough stock to meet all the orders. In this case, the order quantities have to be modified. Planners will communicate with each other if the SKU can be restocked before the loading day. With different types of milk products and some cooking products this might be possible by adjusting production and loading times from production facility. Yo-yogurts, butters and creams rely entirely on forecast as they need to wait for couple of days after the production before these are vendible. All of these are produced in warm temperatures and often arrive to the export warehouse with temperature of 15-20 Celsius. Products will have to stay for 2-4 days on the shelves before their temperature decreases to under 8 Celsius and then they can be sent onwards to the customer. Some products also might need to be set on “quarantine” after arriving to the warehouse, because the production facility has not yet received results from their laboratory about the quality of this production batch. When the results arrive, the production facility will notify the warehouse and these products will be removed from the “quarantine”. If the laboratory finds some abnormality from the batch, defined packages will be sent back to the production facility.

When the quantities of the orders have been modified, the planners will send a report to Company X2’s customer coordinator and sales planners. This report states the ordered and modified amounts. From this report customer coordinator will create order confirmation to the customer and sales planners will adjust the sales plans.

Now that order quantities are clear, the route planning can begin. The export planners of Company X1 will create route plans for the upcoming loading. The route plan determines what order goes to which truck. When route planning is completed, the plan will be sent to 3PL operator’s traffic coordinator who might suggest changes depending on different factors, such as roadworks, unloading times of the customer, their own return loads, etc. When the final plan is completed and pleases both parties, the planners will create deliveries for picking and traffic coordinator will book the necessary trucks. When all the trucks are assigned to each order, a traffic coordinator will create bill of lading for each unloading point. The bill of lading states information such as loading time, customer name and address, the order number, pallets, license-plate number, etc. Bill of lading will be sent via email to export planners.

Export planners will also run the warehouse stock report to determine any “short date” goods. “Short date” good is a product which cannot be sent onwards to the customer, because of the date-requirement of the customer for this product. As the dairy products are easily perishable, the customer also needs time to sell these onwards to the consumers. “Short date” goods often occur when sales have been smaller than the forecasted amount. These goods will be blocked out from the normal picking cycle and marked to the “short date” list, so that the salespersons in Company X2 can try to sell these to customers with a discounted price. When a certain SKU has passed the date-requirement list, the passed amount will be communicated to production planners so that they can adjust production plans accordingly.

When the steps above are completed, the deliveries are sent onwards to the warehouse, where they can start the picking process. The picking process cannot be started before the previous loading day is completely picked. This is to ensure the FIFO / FEFO functionality. For this reason the picking often has to wait until the next day before the picking can begin. Additionally some of the goods will arrive to the warehouse on the loading day. The picking is done via voice controlled picking system, in which the system tells via headphones and computer what to pick from which picking location and where to place this. The picker acknowledges these commands by speaking to the microphone. When a picking-task is completed, this pallet will be packed and labelled, and placed on the assigned loading-platform.

When an order is completely picked, this order can be checked out of the ERP system, producing dispatch note and invoice. After all the orders of the day are picked, the export planners will produce the “actual delivery report” for Company X2 and to the management of Company X1. This actual delivery report states ordered amounts, reductions and availability assumption of the reduced products. Customer coordinator of Company X2 will inform the customers when reduced products are available again.

The 3PL operator’s trucks arrive on the loading day. Each of the trucks has an appointed loading time, when the order must be fully picked. Before the loading can begin, the warehouse will perform “loading-check” and go through each order before giving loading permission to the driver. This loading-check is meant to eliminate errors, such as wrong products ending up to the wrong customer. When the order is fully loaded, the driver will receive the bill of lading and shipping notifications, and the goods are ready to leave the warehouse.

The distribution takes up from 15 hours to 48 hours depending on the location of the customer in Country B. When the truck reaches the customer, the order will be unloaded and customer will perform receiving check for the arrived goods. If everything is okay, the order fulfilment cycle is completed and invoice will be checked out. If customer finds some deviation from the received goods, a complaint to Company X2 is sent. When complaint is dealt with, the invoice will be paid.

4.2 Simulation of the faster order fulfilment cycle

The case Company X2 wanted to simulate faster order fulfilment cycle for one of their biggest customers. The assumption before the simulation was that the order fulfilment time would drop from 3 days (72 hours) to 2 days (48 hours) for one customer. During the simulation, all the other customers left their order normally. This means that they were obeying the normal order cut-off time but the case customer who their order a day later. The simulation lasted for 6 weeks. Table 3 demonstrates the order fulfilment cycle in days during the simulation and figure 6 demonstrates the timeline of the order fulfilment cycle.

Table 3. Order fulfilment cycle in days during the simulation.

<i>Normal order cut-off time for the customers</i>	Order cut-off time during the simulation for the case customer	Customers order departs from the warehouse in Country A	Customer receives the order in their distribution warehouse in Country B
<i>Monday 11:30</i>	Tuesday 11:30	Wednesday	Thursday
<i>Tuesday 11:30</i>	Wednesday 11:30	Thursday	Friday
<i>Wednesday 11:30</i>	Thursday 11:30	Saturday	Sunday
<i>Thursday 11:30</i>	Friday 11:30	Monday	Tuesday
<i>Friday 11:30</i>	Monday 11:30	Tuesday	Wednesday

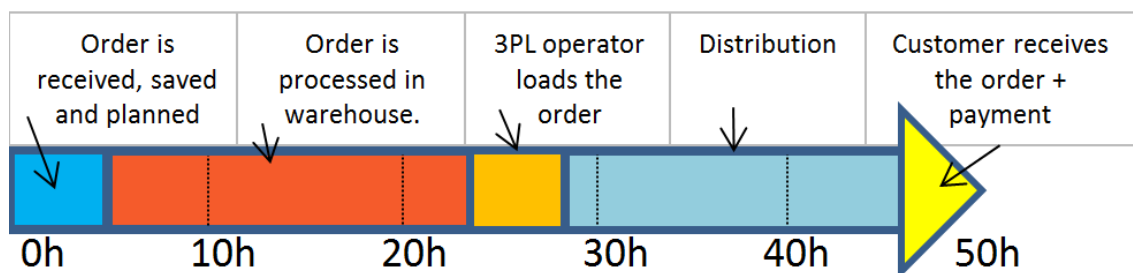


Figure 6. Simulation Timeline of the Order Fulfilment Cycle for the case customer.

The goal of the simulation was to test the internal order processing time of Company X1 when there was only one day to process the orders. The whole order processing window started one day later for operative, testing and data collection reasons. Impacts of the simulation were measured to see how the sales forecast, internal processes, functionality and costs were affected by this change.

4.2.1 Results of the simulation

The faster order fulfilment simulation gave a lot of valuable information. First of all, decreasing the order processing window from two days to one day did not affect the operative side significantly. Of course now that the orders for the upcoming loading day were coming in two batches, some steps had to be done twice. For example, for Wednesday departure, all the other customers left their orders on Monday and customer with faster OFC gave their order on Tuesday. Some tasks like checking order quantities for all the other customers had to be done on Monday in order to send the order confirmation to the customer on the same day. Also 3PL operator wanted to receive a truck-estimation for the upcoming departure, so that they could book some of the truck beforehand.

In some product groups (milks & some cooking products), the change showed that production had to rely on the forecast made by sales planners even more than before. Basically the sales plans were guiding the production totally. In product groups, such as yoghurts, butters and creams, this change did not really have an effect as all these goods were already made against the forecast. Because of the smaller operating window, any “last minute” order-adjustments from customers which required effort from production, had to be eliminated as there was no time to react to these.

In warehouse this change affected slightly. The picking could begin later than normally. In normal scenario, the picking of orders for Thursday’s departure could begin as soon as orders for Wednesday’s departure were fully picked. This meant that picking could often begin on Wednesday around 10-12 am. During the simulation, the last order for Thursday departure arrived on Wednesday around 11. Now that the order was in, it still had to be processed by export planners. This took approximately 3-4 hours more. Finally the warehouse could start the picking around 2-3 pm on Wednesday delaying the process for around 3 hours compared to “normal” cycle. Because of this, the picking

shifted more into evening-/night-oriented. Anyhow, there was no downtime on the picking even though the orders were not in yet as there are multiple other processes within the warehouse which could be completed at the same time. It is also worthy of mentioning that the picking speed was slightly faster than before as the picking rarely had to wait for the goods to arrive to the warehouse. Before, there was more downtime during the picking as some goods were still arriving from the production facilities. Now that picking time had moved to a bit later, the downtime decreased as some loads from production facilities had arrived before the picking began.

Secondly, the service level (SL) to the customers, spoilage costs, stock levels and inventory velocity speed were not significantly affected by the change. Figures 7-11 below show the situation before the simulation and during the simulation. In the figures, blue bars and lines represent time before the simulation and green bars and lines represent the time during the simulation.

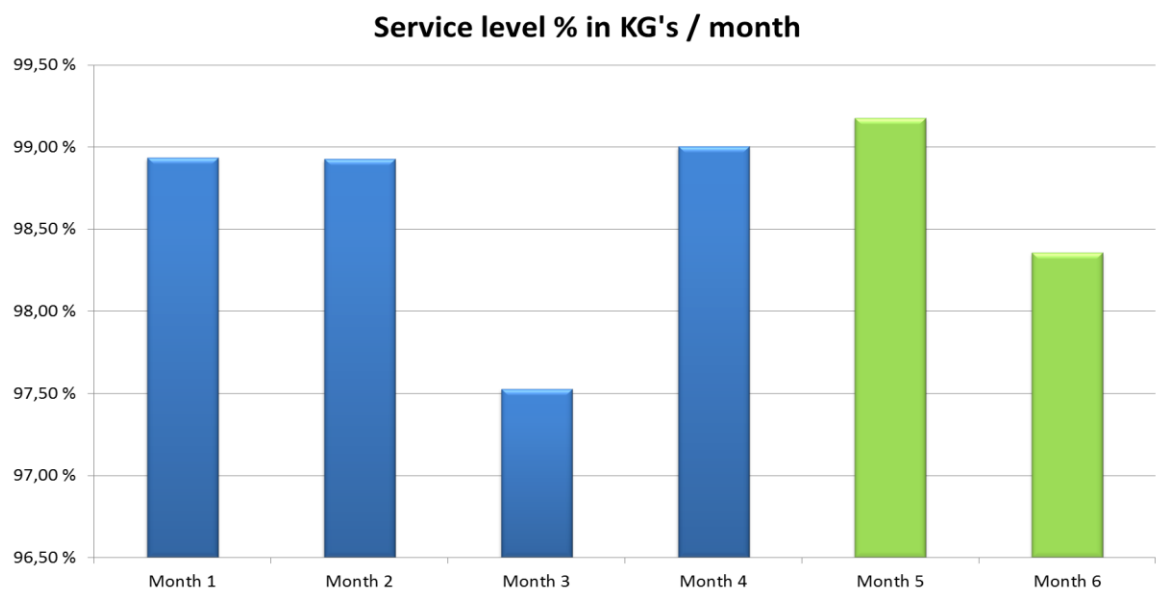


Figure 7. Service level % in KGs / month before and during the simulation (Company X1, 2017). Service level % in kilograms is calculated by delivered kilograms / ordered kilograms. If a customer ordered 100 kilograms and only 98 kilograms would be delivered, the SL would be 98% ($98/100 * 100\%$). As it can be seen from figure 7, the simulation did not significantly affect the total SL % of Company X2. During the first month of simulation (month 5), the SL % was actually higher than during the 4 months before the simulation. On month 6 the service level dropped a little bit, but this drop was not caused by the simulation. The reason for the drop on month 6 was caused by sales prioritisation of butter. The demand was higher than supply in both Country A and Country B, so the

sales of butter were prioritised to Country A for Company X1's own sales. Because of this there was not enough butter available for all the orders of Company X2.

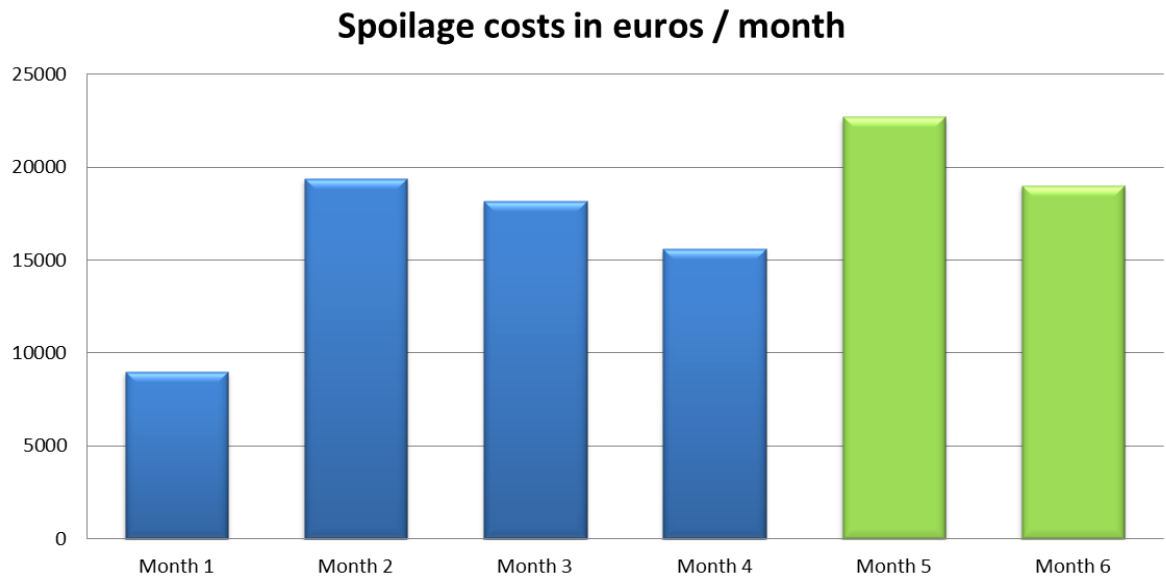


Figure 8. Spoilage costs in euros / month before and during the simulation (Company X1, 2017).

Figure 8 shows that spoilage costs rose during the simulation time compared to months 1-4. However, this increase was not solely caused by the simulation and faster order fulfilment time. The biggest reasons for the bigger spoilage costs were a launch of a new product and a failed campaign. The anticipated demand for a newly launched product was too high and a lot of the first batch had to be sold with a discount and rest had to be destroyed. Also misinformation about a campaign caused some overproduction. During month 6, the spoilage costs were more balanced and did not differ too much from time before the simulation.

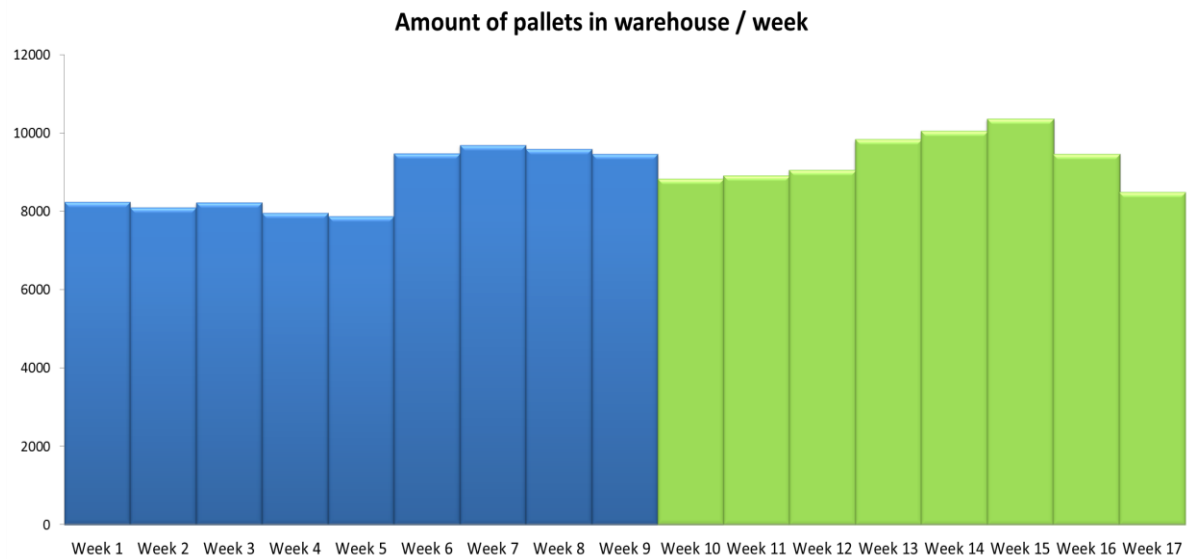


Figure 9. Amount of pallets in warehouse / week before and during the simulation (Company X1, 2017).

Figure 9 shows that stock levels during the simulation were little bit higher than normally. These numbers were recorded on each day at 06:00 am. The higher stock levels were not fully caused by the simulation, but the higher demand of products and campaigns during this time.

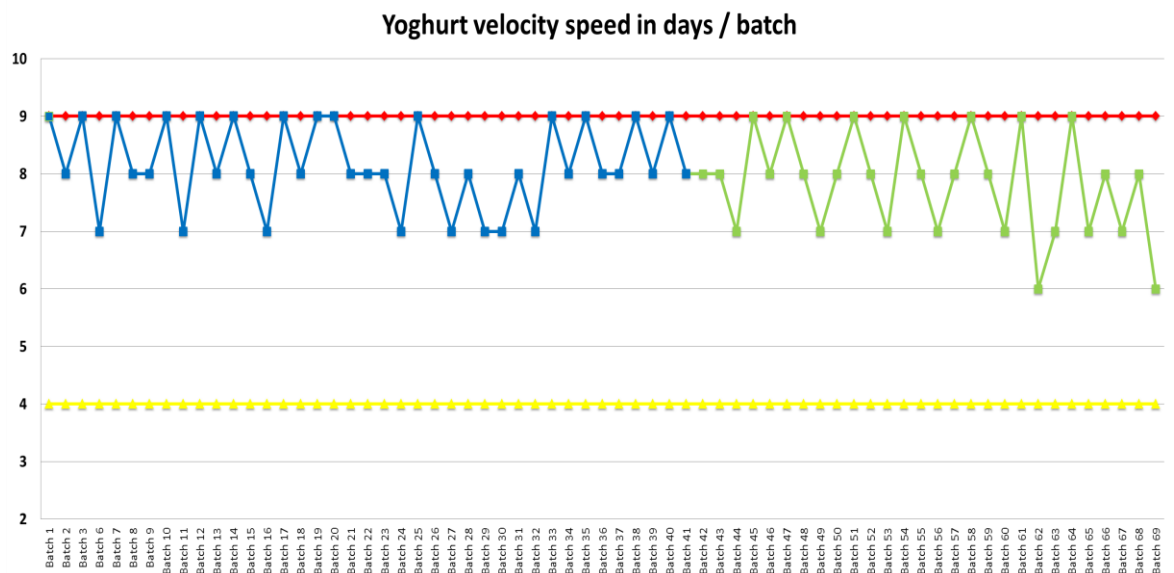


Figure 10. Yoghurt velocity speed in days / batch (Company X1, 2017).

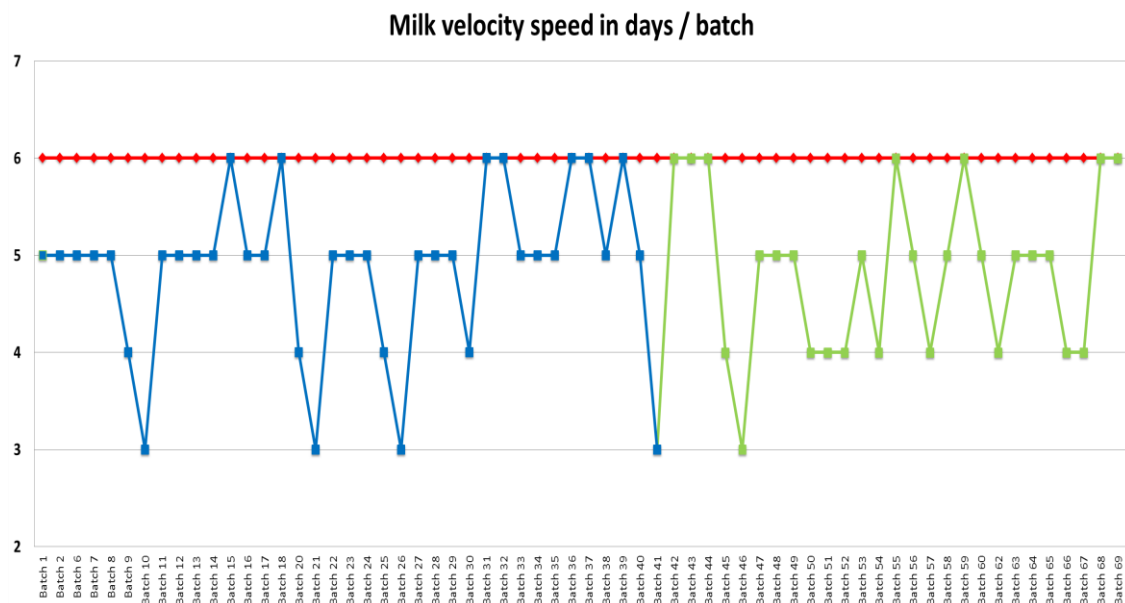


Figure 11 Milk velocity speed in days / batch (Company X1, 2017).

Figures 10 and 11 represent the time that different batches of products spent in the warehouse. Figure 10 shows how many days different yoghurt production batches spent in the warehouse. As mentioned in chapter 4.1.1, yoghurts are produced in warm temperatures and arrive to the warehouse right after production. These yoghurts require 4 days to cool off after the production before they are vendible to the customer. After cool off time, there is 5 days' time to sell these out of the warehouse before the customer date requirement is reached. If the batch is not sold within 9 days of production, the batch will move to the "short date"-list mentioned also in chapter 4.1.1. During the time before simulation the number of average days yoghurt batches spent in the warehouse was 8.15 days. During the simulation the number of average days batches spent in the warehouse was 7.82. From this point of view the velocity speed of yoghurts were better during the simulation. This success can be reflected to successful sales planning and stock management during the simulation.

Figure 11 presents the velocity speed in days of milk products. In milk products, there is no cooling off time and these can be sent onwards to the customer as soon as the batch arrives from production. The maximum time milk products can spend in a warehouse is 6 days after the production. Average velocity speed of milks products was 4.86 days before the simulation and 4.85 days during the simulation. From this point of view, the milk velocity was not affected at all, even though there was one day less operating time.

To conclude, the results of the simulation were mainly positive from the point of view of KPI's. Even though the order processing time window was decreased from 2 days to 1 day, there were no significant effects forwarded to the process quality. The simulation did not affect the total volume as the simulation only included one customer. Longer or broader simulation period would have been needed to provide more reliable results about the change in volume, spoilage costs, pallets stored or velocity speed.

4.2.2 Survey results of the simulation

Two surveys were conducted before and after the simulation to the key members of Company X1 (warehouse shift-leaders, production planners, distribution planners and export planners). The goal was to gather subjective feedback from these members about expectations and realisation of the simulation. In total there were 35 members involved in the survey from which 30 answered both of the surveys. Some of the questions in these surveys were open answer questions and some multiple choice questions with one or more answers to choose from. The tables show the location of the answerer (production facility or warehouse), their answer to the question and the amount of total answers in this category from this location. Some key findings are shown in tables 4-11. The actual surveys are listed as Appendix 2 and 3.

Table 4. Survey results about expectations of the simulation.

Location	Own expectations about the simulation? / General feeling about the simulation?	Total answers in category
Butter production	High	1
	Neutral	2
Cheese production	High	4
Cooking production	Neutral	2
Cream production	Neutral	2
Distribution centre	Neutral	1
Export warehouse	High	2
	Neutral	4
Milk production	High	1
	Neutral	2
Yoghurt + cooking production	High	2
	Neutral	2
Yoghurt production	High	1
	Neutral	4
Total answers		30

Table 5. Survey results about thoughts after the simulation.

Location	General thoughts after the simulation about faster order fulfilment cycle	Total answers in category
Butter production	Neutral	3
Cheese production	High	3
	Neutral	1
Cooking production	High	2
Cream production	Neutral	2
Distribution centre	High	1
Export warehouse	High	3
	Neutral	3
Milk production	High	3
Yoghurt + cooking production	High	2
	Neutral	2
Yoghurt production	High	1
	Neutral	4
Total answers		30

Table 6. Survey results about order fulfilment process becoming more complicated.

Location	Was the process more complicated? In what way?	Total answers in category
Butter production	More monitoring	1
	No effect on the process	2
Cheese production	No effect on the process	4
Cooking production	More monitoring	2
Cream production	Plans based more on forecast	2
Distribution centre	No effect on the process	1
Export warehouse	Distribution planning was more urgent	2
	Picking starting time stretched on some weekdays	3
	No effect on the process	1
Milk production	Last minute changes to production plans had to be made if forecast went well over / under	1
	More monitoring	2
Yoghurt + cooking production	No effect on the process	4
Yoghurt production	More monitoring	2
	Plans based more on forecast	3
Total answers		30

Table 7. Survey results about order fulfilment process becoming easier.

Location	Was the process more relieved? In what way?	Total answers in category
Butter production	No effect on the process	3
Cheese production	No effect on the process	4
Cooking production	No time for last minute changes	2
Cream production	Plans based more on forecast	2
Distribution centre	No effect on the process	1
Export warehouse	No effect on the process	1
	Picking was faster as there were less out of stock moments	3
	Stock management has become easier as there are more pauses in picking	2
Milk production	No effect on the process	3
Yoghurt + cooking production	No effect on the process	4
Yoghurt production	Plans based more on forecast	5
Total answers		30

Table 8. Survey results about change in workload during the simulation.

Location	Change in workload	Total answers in category
Butter production	No effect on workload	3
Cheese production	No effect on workload	4
Cooking production	Little bit more work	2
Cream production	Little bit more work	1
	No effect on workload	1
Distribution centre	No effect on workload	1
Export warehouse	Little bit more work	4
	No effect on workload	2
Milk production	Little bit more work	3
Yoghurt + cooking production	No effect on workload	4
Yoghurt production	Little bit more work	3
	No effect on workload	2
Total answers		30

Table 9. Survey results about the process at the workload change focused on.

Location	What process did the change of workload focus on?	Total answers in category
Butter production	None	3
Cheese production	None	4
Cooking production	Monitoring	2
Cream production	None	1
	Production planning	1
Distribution centre	None	1
Export warehouse	Monitoring	2
	Distribution planning	1
	None	2
	Shift planning	1
Milk production	Production planning	1
	Monitoring	2
Yoghurt + cooking production	None	4
Yoghurt production	Production planning	2
	Monitoring	1
	None	2
Total answers		30

Table 10. Survey results about expectations of the whole cycle speeding up.

Location	If the whole cycle would change into faster one, what are your expectations about this?	Total answers in category
Butter production	Neutral	3
Cheese production	High	3
	Neutral	1
Cooking production	High	2
Cream production	Low	1
	High	1
Distribution centre	High	1
Export warehouse	High	3
	Neutral	3
Milk production	High	3
Yoghurt + cooking production	High	2
	Neutral	2
Yoghurt production	High	2
	Neutral	3
Total answers		30

Table 11. Survey results about comments of faster cycle for all customers.

Location	Comments about faster cycle for all customers	Total answers in category
Butter production	Production is already based on forecast → no effect on the current process	3
Cheese production	Production is already based on forecast → no effect on the current process	4
Cooking production	A lot relies on forecast accuracy	2
Cream production	A lot relies on forecast accuracy	1
	No time for extra adjustments	1
Distribution centre	Works well	1
Export warehouse	A lot relies on forecast accuracy	2
	No time for extra adjustments	1
	Works well	3
Milk production	A lot relies on forecast accuracy	1
	Works well	2
Yoghurt + cooking production	Production is already based on forecast → no effect on the current process	4
Yoghurt production	A lot relies on forecast accuracy	2
	No time for extra adjustments	1
	Production is already based on forecast → no effect on the current process	2
Total answers		30

All in all, the simulation was highly successful from the point of view of key members involved in the daily order fulfilment cycle. Some key findings are presented below:

- 37% of the participants had high expectations about the simulation and 63% had neutral expectations.
- 50% of the participants had positive thoughts about faster cycle and 50% had neutral thoughts.
- 60% of the participants said that some steps of the process got little bit more complicated and 40% said that there was no real effect on the process. Main reasons for the complications were:
 - Forecast being in a bigger role – no possibility to produce against the demand
 - The amount of monitoring increased as orders had to be checked twice in order to send order confirmation to the customers (normal orders came day earlier than the case customer's order – if all the customers were in the same cycle, this monitoring increase would not be relevant).
 - Urgency in distribution planning.

- Picking starting time stretching to later than in the normal model.
- 47% of the participants said that some steps of the process got little bit easier and 53% said that there was no real effect on the process. Main reasons for easiness were:
 - Forecast being in a bigger role – no need to produce against the demand (especially on cream and yoghurt production).
 - No time for last minute changes.
 - Picking was faster as there was less out of stock moments.
 - Stock management was easier as there were more pauses in picking.
- 43% of the participants said that there was little bit more work during the simulation and 57% said that there was no real effect on the workload. Main reasons of workload increase were:
 - Monitoring increased because of double orders.
 - Distribution planning had a more urgent role.
 - Production planning required more time at the start of simulation.
- There was no real effect on costs since 97% of participants said that this simulation caused no extra operative costs. Only one participant mentioned that costs slightly increased.
 - The reason for cost increase was that the picking time was stretched in the exporting warehouse. There were few times when the warehouse was waiting for the orders and had no other processes underway. For this reason, the workers had to do non-profitable work for a while, such as maintenance of the warehouse (cleaning, etc.).
 - Also, as the picking time stretched to later, more employees had to be shifted from morning shifts to evening shifts. Evening shifts are little bit more valuable and therefore it costs more to pick during the evenings.
- There was no real effect on the service level of products from the simulation. All of the participants said that the simulation caused no shortages.
- Overall expectations of all the customers shifting to faster fulfilment cycle were good. 57% of participants had high expectations, 40% had neutral expectations and 3% had critical expectations about the faster order fulfilment cycle for all customers.
- Main comments about the faster cycle for all customers were:
 - Production is already based on the forecast, so no real effect.

- Faster cycle is operatively achievable and works well. There is just no time for extra, last minute adjustments.
- A lot relies on the forecast accuracy. If the forecast is in place, there will be no problem.

As conclusion, the survey showed that the key members have either positive or neutral thoughts about faster cycle. The ruling factor in surveys was the forecasting accuracy. If the faster cycle for all customers helps sales planners to improve their forecasting accuracy, the quality of the order fulfilment in overall will increase. Also, the urgency in some tasks and not being able to do last minute changes were problems, but these are factors which have to be accepted in order to implement the change.

4.3 Changes needed to develop the order fulfilment cycle

In this chapter, the research will aim to point out needed adjustments to move from current order fulfilment cycle time to faster one. The goal is to reduce the order fulfilment cycle time from 3 days (72h) to 2 days (48h) for all the big customers and reduce the OFCT for HoReCa customers from 4 days (96h) to 3 days (72h). The chapter will also cover customer interface changes and any emerging costs concerning the faster cycle time. The following figures and table 12 aim to clarify and give better visual understanding about the goal of the research. Figure 12 presents the order fulfilment cycle time used on different processes before (present) and after. Figure 13 presents the timeline used on these processes and Table 12 presents the order fulfilment cycle in days before and after the change.

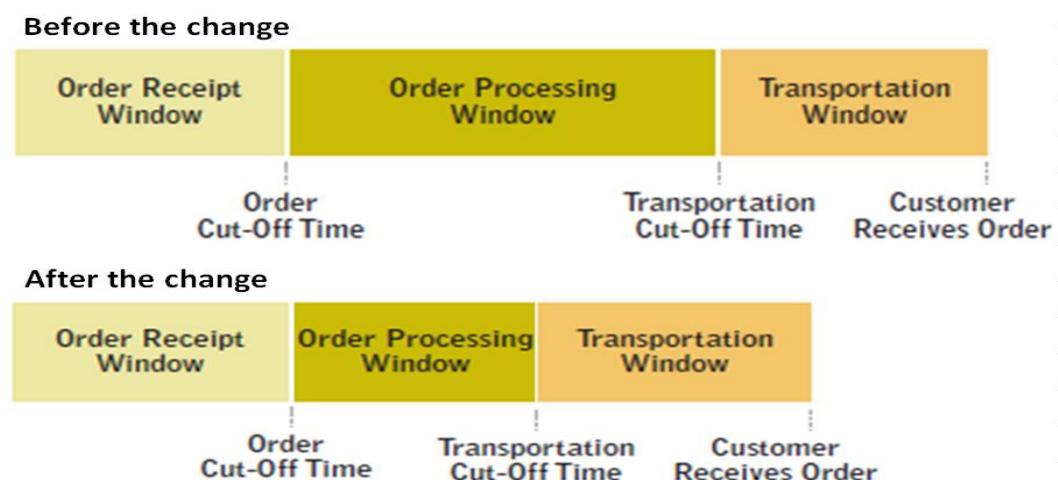
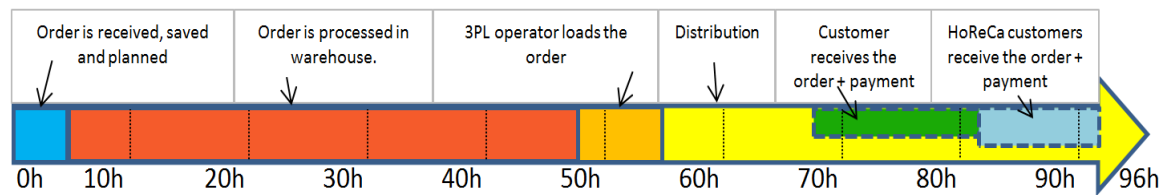


Figure 12. Order fulfilment time-windows before and after the change (Meller, 2015).

Before the change



After the change

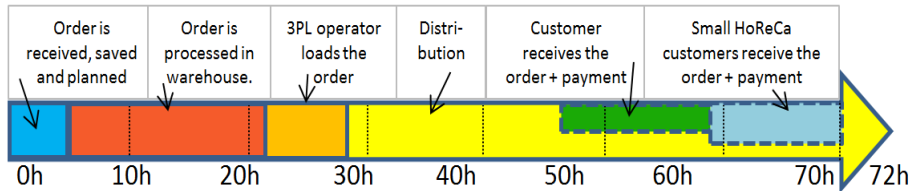


Figure 13. Order fulfilment timeline before and after the change (Company X, 2017).

Table 12. Order fulfilment cycle in days before and after the change (Company X, 2017).

<i>Current order cut-off time for the customers (11:30)</i>	Order cut-off time for the customers after the change (11:30)	Customers order departs from the warehouse in Country A	Customer receives the order in their distribution warehouse in Country B	HoReCa customers receive the order
<i>Monday</i>	Tuesday	Wednesday	Thursday	Friday
<i>Tuesday</i>	Wednesday	Thursday	Friday	Saturday
<i>Wednesday</i>	Thursday	Saturday	Sunday	Monday
<i>Thursday</i>	Friday	Monday	Tuesday	Wednesday
<i>Friday</i>	Monday	Tuesday	Wednesday	Thursday

The simulation about the faster order fulfilment cycle already gave a good view that the faster order processing window is operatively achievable and works well. Some extra work was caused to the key members of the chain because they had to create production plans and check the order quantities twice. This of course will not be necessary if the faster fulfilment model is spread to all customers as all the orders are coming in on the same day.

The biggest question to success is the accuracy of the forecast. On current 3-day-cycle, the production plans for the some milk SKUs and some cooking SKUs can still be modified for the upcoming loading if the actual demand differs a lot from the forecasted demand. For product groups such as yoghurts, butters, creams and cheeses the faster fulfilment cycle does not affect as much as these are already produced against forecast few days earlier before the orders are received. Also, some milk SKUs and cooking SKUs are produced only once or twice a week so these products have to

be produced against forecast as well. Figure 14 presents how the total volume is divided between product groups and figure 15 presents percentage of the total volume for which production plans can still be modified after the orders are received.

Share of the total volume per product group

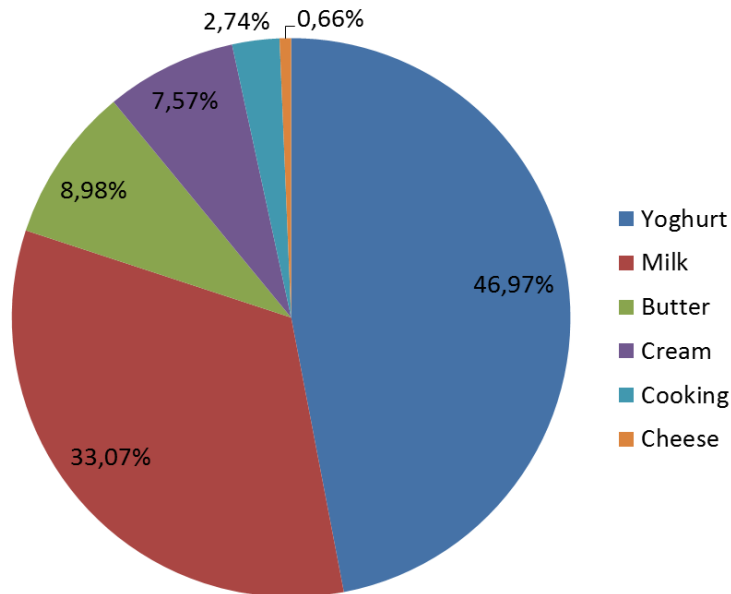


Figure 14. Share of the total volume per product group (Company X, 2017).

Share of the total volume which are currently produced against forecast

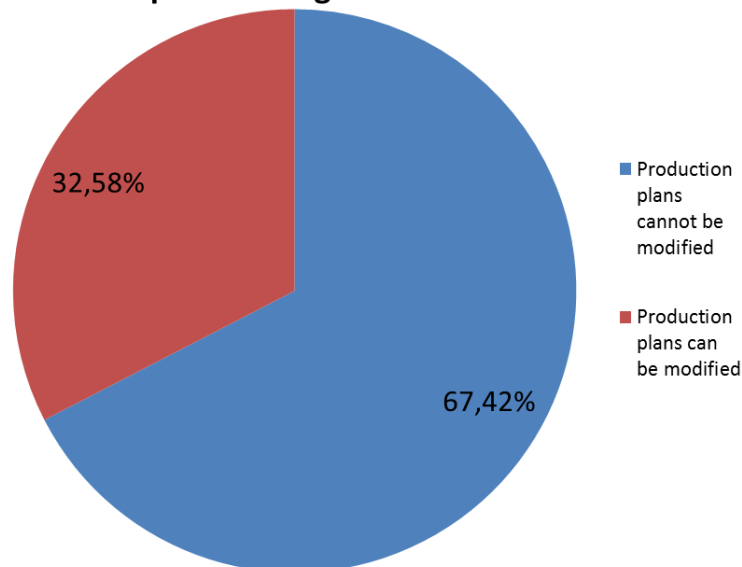


Figure 15. Share of the total volume and how these are currently produced (Company X, 2017).

Figure 14 shows that yoghurts are the biggest category with 47% share and milk products are the second biggest category with 33% share. These two product categories account for 80% of the total volume. Whereas figure 15 presents that approximately 67% of all volume is already based on forecast and production plans cannot be modified after the orders have been received. For example, yoghurts for Thursday's loadings have already been produced on Saturday, Sunday or Monday. Thus, it does not matter whether the order fulfilment cycle is 2 days long or 3 days long as these products have already been produced days before the orders have been received. On the other hand, production plans accounting for approximately 33% of all volume can still be modified on current cycle after the orders have been received. If the cycle is speeded up to 2 days, the production plans for the upcoming loading on some milk SKUs and some cooking SKUs cannot be modified as well as before. Therefore, the production must also rely more on the forecasted demand than the actual demand. This forecasting issue may cause supply shortages if the demand is higher than the forecasted amount and too few are produced, or it may cause spoilage costs if the demand is lower than the forecasted amount and too many are produced.

4.3.1 What operational adjustments are needed?

As the simulation indicated, the faster order fulfilment cycle is already achievable with the current resources. Therefore, there are no major adjustments needed. Mostly the change will affect the process phases by shifting its time frame of tasks from day to another or from hour to another. To figure out what operational adjustments are needed on each phase of the order fulfilment cycle, these processes must be looked one by one.

For production and production planning there are no real adjustments needed at the beginning of the faster cycle. As mentioned above, the production amounts will be entirely based on forecasted demand made by sales planners. From this point of view the production planning will be smoother, as the production plans do not have to be adjusted at the last minutes. Of course the actual demand still has to be monitored and future plans have to be modified accordingly, but the last minute changes are not necessary. It is likely that the production schedule has to be adjusted as time passes, but that is not something that can be yet measured.

If the whole cycle is speeded up, the planners will have to closely monitor the customer order behaviour and pay attention to any transitions on the delivery date volumes. Figure 16 shows the current volume distribution to each departure date with 3 day OFC.

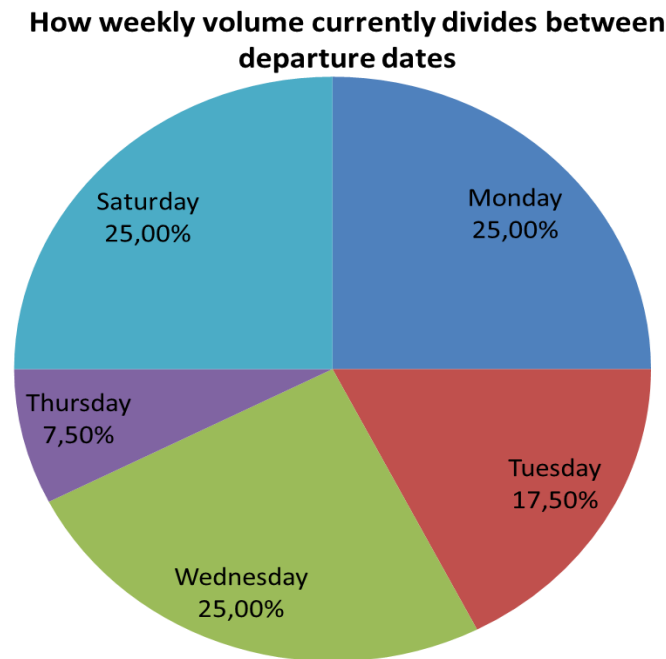


Figure 16. Volume distribution to weekly departure dates with 3-day-cycle (Company X, 2017).

Figure 16 indicates that currently the biggest departure dates are Monday, Wednesday and Saturday, each accounting for 25% of the total weekly volume, cumulatively adding up to 75% of total weekly volume. Tuesday is the second smallest departure date with 17.50% share of total weekly volume and Thursday is the smallest with only 7.5% of total weekly volume. It is possible that with the faster 2-day-cycle, the share of the weekly distribution will shift, giving Tuesday more of the weekly share and reducing the share from Wednesday and Thursday departures. Currently if the customer wants to receive the order on Wednesday (departure on Tuesday), they have to place the order already on previous weeks Friday. With the faster cycle, customers can place their order on Monday and still receive it on Wednesday (departure on Tuesday). Therefore, there is less need to forecast at the customer's end as they are able to place the order later than before and still receive the order on the same day. The weekly volume distribution with the faster cycle is estimated in figure 17.

Assumption how weekly volume will divide between departure dates on faster order fulfilment cycle

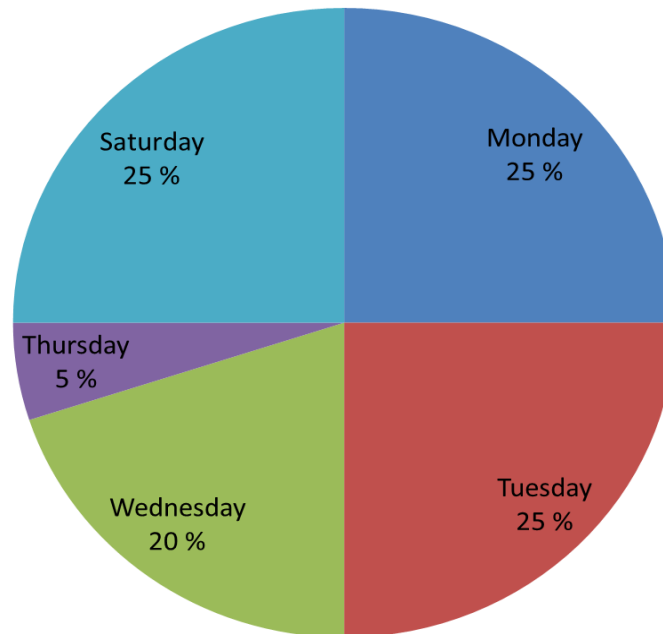


Figure 17. Assumption of volume distribution to weekly departure dates with 2-day-cycle (Company X, 2017).

Figure 17 indicates that with the faster cycle, Tuesday departure day will become as big as Monday and Saturday. Whereas, both Wednesday and Thursday departure days volumes will decrease. If a transition to weekly volume distribution were to happen, all phases need to act accordingly. Sales, distribution and production plans have to be adjusted to match the new departure schedule in order to have the needed goods in the exporting warehouse in time. The production schedule will have to be adjusted to match the new demand. Also, the warehouse resources need to be monitored so there are enough pickers on the busy days and fewer pickers on quieter days.

Daily order preparation for the picking will definitely become more urgent than before. With faster fulfilment, the order processing window will shrink by 50% (from 2 days to 1 day) and for this reason, the orders must be forwarded to the warehouse as fast as possible so the picking can begin. Therefore, as soon as all the daily orders have been received, the preparation must begin. The export planners and customer coordinator must pay close attention around the order cut-off time and as soon as all the orders have been received, the export planners must inform production and distribution planners that the orders for next day's loading have been received. If some big customer's

orders are running late, the customer coordinator will have to contact their purchaser immediately and ask when the order will be received as all the big chains have fixed delivery dates.

After receiving all the orders, the order quantities will be checked and planners will communicate with each other about availability of products. When availability has been confirmed and possible reductions done, one of the export planners will have to inform sales about reductions and the other one will have to begin the route planning. Now that the planning is more urgent, it is important to get the route plans to 3PL operator as fast as possible so they are aware about the need of trucks for the upcoming loading. It is preferable that if it is possible the 3PL operator's traffic coordinator will give any route plan suggestions or planning criterion beforehand to the export planners, so there will not be extra time wasted in the route planning process. All in all, effective communication and continuous collaboration between the stakeholders is the most important key to success. Without these, the order "preparation" process will consume extra time. Therefore, the stakeholders must be aware about the daily order schedule (when orders should arrive, when route planning should be completed, etc.) so they can be ready when it is time to act.

Export planners should also provide 3PL operator "truck amount estimation" for each departure day one week beforehand. For example on previous week's Thursday the export planner could send table to the 3PL operator's traffic coordinator with estimation how many trucks are needed on Monday, how many on Tuesday, etc. This estimation would be based on the forecasted kilograms + tare weight (weight of pallets, packages, etc.) for each of the next week's departure days. Of course, the forecasted kilograms is not exact as the daily demand changes, but the forecast will give the 3PL operator an estimation what to expect for the upcoming week. The truck estimation will most likely be quite precise with +/- 1 truck accuracy for each departure day.

The warehouse process does not require too many operational changes. It is important to maintain the continuous picking flow and try to be as efficient as possible. As the simulation showed, there will be less stock-out moments in the picking as most of the needed goods are already in the warehouse as the orders arrive. Fast and effective replenishment of picking locations is important as the pickers should not have to stay still and wait for any extra time. Also, the picking of full pallets directly from the receiving area should be prioritised as there is no need to store these. Currently it is mostly

the milk SKUs which can be picked directly from the receiving area as these are already cold when they arrive to the warehouse and can be directly picked to orders. In 2018, a totally new yoghurt production line will be finished. This new line will be utilising technology for yoghurts, meaning that the produced yoghurts will go directly through the cooling line after production. When the yoghurts go through the cooling line, these will not require cooling in the warehouse as their temperature is cold already when they arrive. This will allow the picking of yoghurts directly from the receiving area in the future.

Warehouse shift-leaders must be aware of the picking situation at all times and assign pickers to needed tasks if necessary. It is not efficient to have all the pickers doing the same tasks as the picking locations will get crowded. It is important to distribute pickers to different picking tasks within the warehouse (full pallet picking, manual picking, picking from receiving area). Also, as soon as all the pallets of departing truck are picked, one picker should be assigned to inspect the picked goods. Even though the inspection does not create extra value to the customer, it will considerably reduce the quality costs caused by faulty deliveries to wrong customers and human errors.

Warehouse safety stock levels should be kept higher than normal at the beginning of the faster cycle, even though it may result in some spoilage costs. By keeping high safety stock levels, the case company is able to minimise supply shortages and keep the service level high for its customer (creating value for the customer). As time passes and sales planners get to know the new customer order behaviour better, the safety stock level can be dropped gradually and the total cost of the supply chain will be reduced.

Other operative changes are not that necessary. Of course there are ways to fasten the order cycle by integrating information systems with smaller customers. This is important because the orders can be received via EDI and do not require customer coordinator to manually enter these. However, all of the main customers (chains) and many smaller customers are already integrated to the system so the orders do not require manual entering. Upgrading current pallet labels with barcodes to RFID labels would be an improvement which brings better traceability to the chain. Also, utilisation of Internet of Things (IOT) is one possibility to increase the traceability of the chain. This again would reduce errors and increase service level (increased customer value), but it is not

a crucially needed change which has to be implemented before the faster fulfilment can take place.

4.3.2 How customer will be affected by the change?

The biggest impact of the order fulfilment cycle change will focus on the customer. There are plenty of factors such as product availability, service level, additional orders, modifications to already received orders and forecasting at the customer's end.

In the start of a faster cycle, product availability and service level to the customer will totally depend on the success of sales planning. Now that the time used to complete the order processing window will be reduced to 50%, there will not be enough time to produce against the demand. Therefore, sales planning will have even bigger role than before as their forecasts will guide the production and distribution completely. It is likely that the service level and product availability will suffer in the beginning as sales planning will be struggling with new delivery days. As the customers are able to place their order a one day later than before, this will definitely shift the weekly delivery schedule (see figure 17). For example, there might be a scenario that with current 3-day-cycle, the demand of yoghurt SKU A is 8000 kilograms for Tuesday's loading and 10000 kilograms for Wednesday's loading. With the faster 2-day-cycle it is possible that the demand for the same SKU will shift the other way around and 10000 kilograms will already be required for Tuesday's loading and 8000 kilograms for Wednesday's loading.

Sales planning must notice any kinds of changes in customer order behaviour as soon as possible to avoid supply shortages and over stocking (spoilage of goods). The high safety stock in the beginning of the faster cycle will reduce the shortages caused by forecast being under the actual demand, but in the long run it is not efficient to keep high safety stock as the spoilage costs will be relatively high when demand goes under the forecast. Yoghurts are currently the biggest volume product category (with 47% of total volume) as figure 14 indicates. Yoghurts are also the most challenging category for sales planning as there is a long cooling time, big demand in variation and high customer date requirement (short sales time). When the new production line with a cooling technology for yoghurts starts operating and yoghurts will arrive to the warehouse already cooled after production, the sales planning will become easier and more flexible.

As time passes with the faster cycle, historic sales data with new loading dates will be acquired and knowledge of the customer order behaviour will increase. By combining

historic order data, order trends, retailer's sales, customer order behaviour, current stock levels of the Company X1, current stock levels of the customer centres, etc. the sales planning should be able to create sufficient forecasts about the upcoming demand. With a 3-day-cycle customer's buyers had to forecast their sales a lot more than with the faster 2-day-cycle. With the new model, the need to forecast reduces as customers are able to place the order day later. Therefore, the orders will likely become more predictable and customer order behaviour better interpreted. When everything goes as planned and sales planners are able to create accurate forecasts, it will create huge value for the Company X1, X2 and the customer. Company X1 is able to keep smaller safety stock (less costs), Company X2 can maintain high service level with low spoilage costs, and customer will receive the products they ordered with high shelf life.

With the faster cycle customers are no longer able to place additional orders after the order cut-off time has passed. Small modifications can be made on occasion, but bigger modifications which will require change of route plans or additional trucks will be automatically forwarded to the next possible loading date. This of course may cause harm to the customer, but as the order processing window is tight, there is no efficient way to modify big changes which will require additional trucks to orders already in picking. 3PL operator has also tight window to book the necessary drivers and trucks for each loading and it is often not possible to get available truck and driver with a short notice.

4.3.3 What sort of costs and risks will emerge from the change?

There are few factors which will increase the supply chain costs if the change is implemented. These are mostly temporary costs which can be reduced after some time has passed and knowledge about customer order behaviour has increased.

If the order fulfilment cycle is expedited to 2 days instead of 3 days, the customer order behaviour will definitely change. The sales planners must adjust the forecasts to match the new order behaviour and volume distribution to each departure day. As there is no exact demand data available with the new order cycle for all the customers, the forecasting will be mostly based on the data of the old 3-day-cycle and on assumptions about how the demand will shift. Therefore, the forecasts are not that reliable in the beginning and the supply chain must keep higher safety stocks on SKUs in order to avoid the service level decreasing to the customers. The high safety stock causes addi-

tional costs in warehousing as more shelf space must be reserved for the extra pallets and the space cannot be used more efficiently. High safety stock is also an issue when forecasted demand is lower than the actual demand and the stock does not move as planned. When the forecasted amount is higher than the actual demand, there is a risk that the batches will be too old to be sent to the customer and these will become “short date” goods. Sales will try to sell “short date” goods to customers with a significant discount, but often the sales revenue received from these sales does not cover the variable costs of production, handling and transporting of these goods. Anyhow, the short date sales are often better option than complete disposal of goods as long as these short date sales do not deduct the amount of normal sales (giving full price). If the products are not sold to customers’ at all, they must be disposed by giving them to the staff, personnel stores, charity, or as the final option, destruction. When products are disposed, they do not bring any revenue to the Company X2 and will cause negative profit because resources have been used for production, transport and warehousing of these products as well as possible dumping costs.

On the other hand, forecasting failures in beginning of the process may cause fulfilment problems when the actual demand is higher than forecasted demand. Even though there is high safety stock, there are cases when this simply is not enough. When the demand for some SKU is higher than available stock, the orders cannot be fully fulfilled. This again will cause loss of revenue, as the company obviously cannot charge for undelivered goods. If the company cannot deliver a product which the customer wanted, he will order this from the competitor. Therefore, it is highly important to keep the service level high for the customers or in the long run a company may lose significant market share to their competitors.

These both costs are mainly temporary and mostly present in the beginning of the change. As the sales planning gets better, data and knowledge about the orders and order behaviour is improved and they are able to create more accurate forecasts. When forecasts get more accurate, the safety stock can be gradually reduced. Sales planning plays a key role in the faster order fulfilment process and its success fully determines the cost movement. Also, the new yoghurt production cooling line will ease the work of sales planning by giving them more flexibility as yoghurts start arriving to the exporting warehouse already cooled and the sales time on these will increase significantly.

The supply chain will also face increased labour costs to some extent. This is more permanent cost as there will be less time to process the orders in the warehouse and the warehouse can begin picking later than before. With a 3-day-cycle, picking often began the day before departures around 10-11 am. Now as the orders are received later, the picking can begin around 2-3 pm which is 3 to 4 hours later than before. Therefore, the picking will be more evening and night-based. This means that more picking resources will be required in more costly evening and night shifts instead of morning shift. The shift salaries are priced in the following way: morning shift from 6-14 is base salary, evening shift from 14-22 is 15% more costly than the morning shift, and night shift from 22-06 is 30% more costly than the morning shift. For example, if the base (morning) salary is 20 euros per hour, evening shift will cost 23 euros / hour and night shift will cost 26 euros / hour. Therefore as majority of the work has to be done during the evenings and nights, the labour costs will rise. The same problem may also emerge in production or distribution when they too adjust to the new order cycle better. However, currently there is no sign of this problem.

The emerging costs are relatively small compared to the possible benefits that the change will bring as the change does not require huge investments (i.e. new machines or more staff) or adjustments (i.e. re-organising warehouse or new IT-systems). Of course there is always a chance that hidden costs may emerge, but with continuous supply chain monitoring these can be pinpointed and action can be taken. At some point, an investment in the RFID-technology or other relevant traceability technology should be considered and research made to study the possible costs and benefits. However, this investment is not currently relevant for the order fulfilment problem.

5 Conclusion

Functional and efficient order fulfilment is important for customers when they are choosing a new supplier or evaluating existing one. In dairy industry this is especially the case as the fresh products have quite short shelf life and there is a risk that the products have to be disposed due to the spoilage of goods. This causes unnecessary loss of revenue. Speeding up the order fulfilment process holds numerous of benefits for both the supplier and the customer. However, there are also multiple costs and quality issues that need attention before the change should be executed. Both of these costs and benefits must be carefully estimated before the change is implemented.

5.1 Costs and benefits for the case Companies X1 and X2

The simulation of a faster order fulfilment cycle indicated that the supply chain is already capable of operating in the faster 2-day-cycle. However, the quality of the service level should not significantly suffer and the spoilage costs increase when implementing the faster OFC. Therefore, the key factor for success will be the quality of sales planning and their forecasts.

As already discussed in chapter 4.3.3 there are multiple costs and risks, such as service level reduction costs and increase in disposal costs, but these are mostly temporary costs in the beginning of the change. Mostly the only permanent costs there will be are the labour costs, which will increase due to the processing time shifting to later hours, and causing the picking work to be done in more costly evening and night shifts. Other hidden costs (i.e. picking errors increasing due the rush) may arise, these which have not been yet discovered. Therefore, the processes must be continuously monitored and measured so that these hidden costs can be spotted and dealt with.

Speeding up the cycle offers many benefits for the supplier. These benefits can be divided into two categories: Benefits which will increase the sales and strengthen the market position, and benefits which will strengthen the operative process.

Benefits increasing sales and strengthening the market position include:

- Customers' own sales to consumers are higher than anticipated. Retailers are running out of stock and desperately need additional products to avoid lost sales. With faster cycle, the customer is able to get the needed products faster from the company and do not have to wait for 3 days until fulfilment. Earlier with a 3-day-cycle, the customer most likely turned to the competitors instead of Company X2 because the competitors were able to deliver the goods faster. Now with the 2-day-cycle, the customer is more likely to turn to the Company X2 for the needed products, and thus results positive sales revenue.
- Faster cycle allows the Company X2 to gain totally new customers. Some customers value the fast fulfilment highly in fresh dairy products to avoid risks of lost sales or need to dispose goods. Now with the faster fulfilment these customers might consider Company X2 as more potential supplier. Also, now that the order processing is faster, the Company X2 can spend more time on transportation allowing them to access totally new geographical locations.

- Customer satisfaction increases as they are able to receive the goods faster. Customer satisfaction leads to multiple things: stronger market position, customer loyalty and stronger negotiation power.
 - Stronger negotiation power can provide Company X2 with benefits, such as better shelf placement inside stores, less price discounts and possibility to negotiate the customer's date requirement for later giving the company more flexibility with forecasting.
- Customers are likely to consider Company X2's products when choosing new assortment to the stores. Bigger assortment in customers' stores means bigger sales revenue and bigger market share.

Benefits strengthening the operative process include:

- Less change requests after the order cut-off time as there simply is not enough time for these. There is no need to adjust the process which will result a smoother order fulfilment.
- Production and distribution are totally guided by the sales planning and forecasts. This means that there is no longer need (or possibility) to do last minute adjustments to the same-day-production plans after the daily orders have been received.
- Better predictable customer order behaviour resulting in better quality forecasts.
 - Better quality forecasts result in better service levels and less disposed goods as the supply chain is able to react to the demand better.
 - The safety stock levels can be reduced as the forecasts are more reliable. Free space in a warehouse can be utilised for other needs and less capital is tied up in inventory.
- Order processing is smoother as there is less down-time in picking. As the picking starts later, most of the needed goods have already arrived to the exporting warehouse and are ready to be picked.

There are a lot more benefits than costs for the case company, as the supply chain can already operate in faster cycle and no major adjustments or investments are required. However, if the sales planning is not able to conduct solid forecast, the supply chain and whole company will highly suffer from this as production is no longer able to react to the actual demand for the upcoming departures. Therefore, the success of sales planning mainly determines the success of the development.

5.2 Costs and benefits for the customers of Company X2

Fast fulfilment cycle is important for retailers as this will reduce the risk of good shortages which will result in lost revenue. It will also reduce the risk of overstocking a product which is causing possible disposal needs and therefore reducing the need to forecast as much as before. There are multiple other benefits, but there are also downsides for the customers.

Costs and risks for the customers are:

- Not being able to place additional orders after the order cut-off time like was done before. Therefore, all additional orders must be moved to the next possible departure date. When all the orders have been received and the order cut-off time has passed, the production plans are adjusted, route plans are made and needed trucks and drivers are ordered from the 3PL operator. As the order processing time is quite narrow, there is simply no time to modify the already placed orders.
 - However, if the order is moved to next possible departure, it will still be received in the same cycle as the old model was. For example, customer places an order on Monday for Wednesday delivery. After placing the order, the buyer realises that he ordered too few of some SKU. Now as the order cannot be anymore adjusted, his additional order will go to Thursday delivery (which he can place on Tuesday). On the current 3-day-cycle when customer placed an order on Monday, they would receive it on Thursday. So basically, there is no significant difference to the old cycle.
- Service level might suffer if the supplier is not able to conduct solid forecasts. This will result in lost sales for the customer as some of the ordered goods cannot be delivered.

Benefits for the customer are:

- The need to forecast the demand at customer's end decreases. As the customer is able to place the order later, they will have better knowledge of their own demand.
 - When customers are better aware of their own demand, they are able to place more formulaic orders and sales planners of Company X2 will gain better knowledge about their order behaviour and have better re-

- sources to conduct solid forecasts. Service level increases and customer are able to receive what they ordered.
- When customers' own orders are formulaic (i.e. big order on Monday, smaller order on Tuesday, big order on Thursday, etc.), they are able to optimise their own operating processes to match the orders by resourcing extra staff to receive the order on days of big volumes.
 - As forecasting becomes more solid, the Company X2 does not have to keep so much safety stock. Less stock in a warehouse equals better inventory turnover and customer receives products with better date. This gives the customer more sales time.
 - Customers are able to keep smaller safety stock as they are able to receive the goods faster. The free space in a warehouse can be utilised for other items.
 - Supplier with satisfying order fulfilment is a great partner to have as their whole product assortment is available to customer's stores. Therefore, if there is a product available what customer wants to have in their store, they do not need to find another supplier to deliver these. It is always cheaper to use existing supplier than to establish a completely new partnership with another one.

There are a lot of benefits for the customers and only few possible costs. One of these costs is not relevant if the supplier is able to perform its own process well and another cost does not really differ from the current way of doing. Benefits on the other hand are significant and will help the customer's own purchasing and operating a lot.

5.3 Critical analysis of the research

The research process was complicated as a lot of primary data had to be acquired through different data collection methods within the company. Also, there was very limited amount of secondary data available about dairy order fulfilment cycle and its development. Primary data was highly reliable and applicable as this was obtained directly from the key members of the supply chain and from the Company X's own ERP system's raw data. The chosen data collection and analysing methods were suitable for the research process.

The results of the research and simulation were positive for the Company X and the results support the execution of a faster order fulfilment cycle. As the change is already

operationally achievable and does not require massive investments or other huge adjustments, the costs of achieving the wanted change are quite low. Of course there is a risk as the succeeding of sales planning determines the success of the whole supply chain. In the worst case scenario the failure of sales planning will harm the whole organisation a lot and cause significant losses in revenue and market position. If the change is implemented, other hidden costs not covered in this research might emerge. Longer or wider simulation period would have been needed to provide more reliable results about possible hidden costs. Any emerging costs should be closely analysed and necessary action should be taken to mitigate these costs. If the costs are significant, the order fulfilment cycle change decision should be re-evaluated.

The results of the research are applicable to similar fast-paced food industry companies with short shelf life that are looking to achieve faster order fulfilment cycle. Especially companies that have long order processing window and are producing or purchasing their goods against the actual demand can relate to the research. By making the sales planning guide the whole supply chain, the supply chains are able to operate in a faster cycle as the production and/or the purchasing is fully based on the forecasted demand. Some investments will be required as the inventory will tie up more capital than before and with higher inventory comes more costs. Also, depending on the supply chain, major investments into more advanced IT-systems or more functional distribution centre might be required. The costs, risks and benefits should be analysed closely case by case, before making a decision to move into faster order fulfilment cycle.

5.4 Recommendations

From the point of view of the researcher, the change should be implemented as there are many significant benefits to be achieved. These do not require huge investments or adjustments. The change of order cycle will significantly strengthen Company X2's market position and provide extra sales. Also operatively the change is needed as there are currently some problems with the forecast accuracy. Faster order fulfilment may provide the answer to these. The change will bring some extra labour costs, but the possible extra sales, enhanced market position and reduced disposal costs will presumably override these costs.

The execution of the change should be scheduled at the same time with the new assortment period which takes place in January-February 2018. At that point, the new yoghurt line with advanced technology will also be operational. Therefore sales planning of yoghurts will be more flexible. Also at this point, major holidays such as Christmas and New Year, are over, and there is still 2-3 months until Easter. Major holidays always cause special arrangements in the order fulfilment cycle and it is often wise not to implement a change close to these holidays.

5.5 Suggestions for further research

The research was mainly focused on the simulation and change needed to achieve the faster fulfilment. Additional study focusing on the results of the change from the point of view of Company X1 and X2 could be especially beneficial. The study should focus on the following factors:

- Service level before the change and after
 - Has the service level increased or decreased? Are there some specific product categories affected by the change?
- Disposal costs before and after
 - Have the disposal costs increased or decreased? Are there some specific product categories affected by the change?
- Forecasting accuracy before and after
 - Has the forecasting accuracy increased or decreased? Are there some specific product categories affected by the change?
 - Has the customer order behaviour changed and how?
- Operational costs before and after
 - Has the forecasting accuracy increased or decreased? Are there some specific processes affected by the change?

Also, studies focusing on customer satisfaction, acquiring new potential customers outside of the current geographical locations, implementation of traceability technologies (such as IOT – internet of things or RFID) in the supply chain could be beneficial to further development of the business and its operations.

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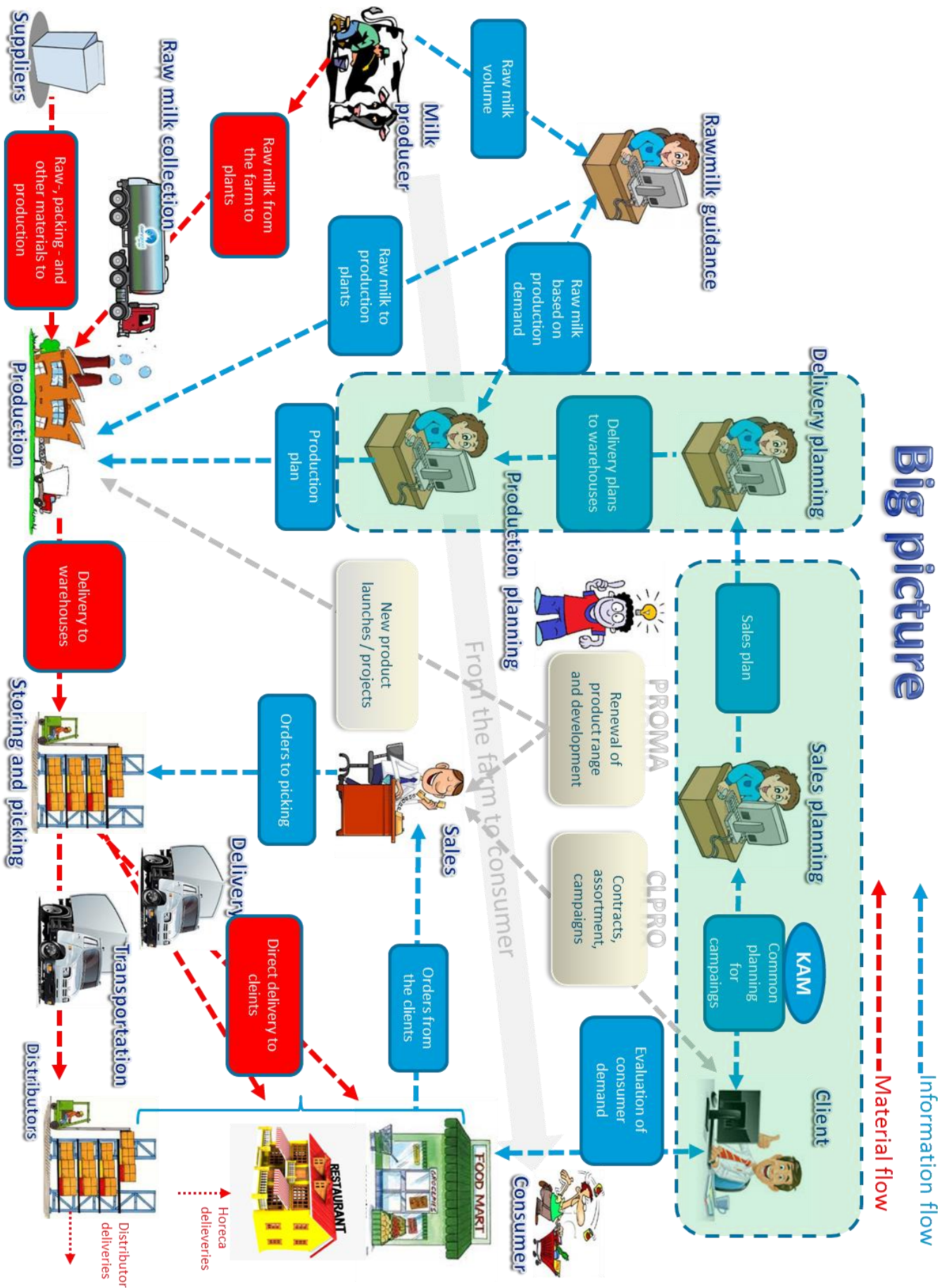
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Appendix 1 Dairy Supply chain – Big Picture



Appendix 2 Survey on expectations of the simulation

This survey is meant to analyse the results of faster order fulfilment cycle simulation for case customer. The simulation begins on departure date 18.10 continuing for 6 weeks and ending to departure date 29.11.

There will be in total two (2) different surveys. The first survey is filled before the simulation and the second after the simulation. The survey aims to bring out opinions about the simulation from the point of view of members involved in the order fulfilment cycle to Country B.

Name:

Organisation:

Location:

Task:

Own expectations / General feeling about the simulation?

- ☐ High
- ☐ Neutral
- ☐ Low

Will the simulation affect you?

- ☐ Yes
- ☐ No

Which processes do you think the change will affect in your location? *(Choose all options which are relevant)*

- ☐ No effect
- ☐ Raw material / packaging material procurement
- ☐ Production planning
- ☐ Production
- ☐ Warehousing / Picking
- ☐ Distribution planning
- ☐ Distribution to exporting warehouse
- ☐ Something else, what? Write down the processes

Do you think the change will affect your tasks?

(Write down the tasks in which you think the change will focus on. If there are none, leave empty!)

How do you think your workload will change? (Pick one)

- ☐ A. A lot more work
- ☐ B. Little bit more work
- ☐ C. No effect on workload
- ☐ D. Little bit less work
- ☐ E. A lot less work

If you chose A or B for the question above, in which task do you think the extra work focus on and how?

If you chose D or E for the question above, in which task do you think the workload will be relieved on and how?

Do you think the change will complicate or ease some process at your location? In which process does the change focus on and how? (Choose all options which are relevant)

- ☐ No effect
- ☐ Raw material / packaging material procurement
- ☐ Production planning
- ☐ Production
- ☐ Warehousing / Picking
- ☐ Distribution planning
- ☐ Distribution to exporting warehouse
- ☐ Something else, what? Write down the processes

If you chose something else than "No effect", how do you think that the process complicate or ease?

Do you think that the simulation will complicate or ease some of your task?

(Write down which of your tasks gets more complicated / easier and how?)

Do you think that the time window of some process changes in your location? In which process does the change focus on? (Choose all options which are relevant)

- ☐ No effect
- ☐ Raw material / packaging material procurement
- ☐ Production planning
- ☐ Production
- ☐ Warehousing / Picking
- ☐ Distribution planning
- ☐ Distribution to exporting warehouse
- ☐ Something else, what? Write down the processes

Do you think that the costs at your location increase or decrease due the change?

- ☐ Increase
- ☐ No effect
- ☐ Decrease

If you chose that the costs will increase or decrease, in which process do you think that the change will focus on?

- ☐ Raw material / packaging material procurement
- ☐ Production planning
- ☐ Production
- ☐ Warehousing / Picking
- ☐ Distribution planning
- ☐ Distribution to exporting warehouse
- ☐ Something else, what? Write down the processes

If you chose some of the processes above, in which direction do you think the costs will move and why?

How do you think that the service level of your location's SKUs will be affected?

- ☐ Service level increases
- ☐ No effect
- ☐ Service level decreases

If you chose the service level to increase or decrease, do you think that the change will focus on all products or certain product categories / SKUs? List the product categories / SKUs and in which direction do you think that the service level will move on these?

Free word concerning the simulation.

Feeling / expectations?

Comments about the service level?

Comments about the time window?

Comments about the tasks?

Comments about costs?

Something else?

Appendix 3 Survey on results of the simulation

This survey is meant to analyse the results of faster order fulfilment cycle simulation for case customer. The simulation began on departure date 18.10 continued for 6 weeks and ended on departure date 29.11.

The survey aims to bring out opinions and results about the simulation from the point of view of members involved in the order fulfilment cycle to Country B.

Name:

Organisation:

Location:

Task:

General thoughts after the simulation about faster order fulfilment cycle ?

- ☐ High
- ☐ Neutral
- ☐ Low

Did the change affect you?

- ☐ Yes
- ☐ No

In which processes did the change affect on your location?

(Choose all options which are relevant)

- ☐ No effect
- ☐ Raw material / packaging material procurement
- ☐ Production planning
- ☐ Production
- ☐ Warehousing / Picking
- ☐ Distribution planning
- ☐ Distribution to exporting warehouse
- ☐ Something else, what? Write down the processes

Did the change affect your tasks?

(Write down the tasks in which the change will focus on. If there are none, leave empty!)

Did your workload change because of the simulation? In which direction? (Choose one)

- ☐ A. A lot more work
- ☐ B. Little bit more work
- ☐ C. No effect on workload
- ☐ D. Little bit less work
- ☐ E. A lot less work

If you chose A or B for the question above, in which task did the extra work focus on and how?

If you chose D or E for the question above, in which task did the workload relieve from on and how?

Did this change complicate or ease some process in your location? In which process did the change focus on and how? (Choose all options which are relevant)

- ☐ No effect on the process
- ☐ Raw material / packaging material procurement
- ☐ Production planning
- ☐ Production
- ☐ Warehousing / Picking
- ☐ Distribution planning
- ☐ Distribution to exporting warehouse
- ☐ Something else, what? Write down the processes

If you chose something else than "No effect", how was the process complicated or relieved?

Did the process complicate or relive some of your task? (Write down which of your tasks were complicated / relived and how?)

Did the time window of some process change because of the simulation? In which processes did this change focus on? (Choose all options which are relevant)

- ☐ No effect
- ☐ Raw material / packaging material procurement
- ☐ Production planning
- ☐ Production
- ☐ Warehousing / Picking
- ☐ Distribution planning
- ☐ Distribution to exporting warehouse
- ☐ Something else, what? Write down the processes

Did the costs at your location increase or decrease due the simulation?

- ☐ Costs increased
- ☐ No effect
- ☐ Costs decreased

If you chose that the costs changed, in which processes did the change focus on?

- ☐ Raw material / packaging material procurement
- ☐ Production planning
- ☐ Production
- ☐ Warehousing / Picking
- ☐ Distribution planning
- ☐ Distribution to exporting warehouse
- ☐ Something else, what? Write down the processes

If you chose some of the processes above, in which direction did the costs move and how?

How did the service level of your location's SKUs change?

- ☐ Service level increase
- ☐ No effect
- ☐ Service level decreased

If you chose the service level to increase or decrease, why did this happen? List the main reasons for service level changes (I.e. Accuracy of the forecast, no time for adjustments, etc.)

If you chose the service level to increase or decrease, did the change focus on all products or certain product categories / SKUs? List the product categories / SKUs and in which direction did the service level move on these?

If the whole cycle was moved in to faster cycle, what is your expectation about this?

- ☐ High
- ☐ Neutral
- ☐ Low

Free word concerning the simulation.

Own thoughts / expectations about the faster simulation and continuing of it?

Own thoughts about the faster cycle for all the customers? (All customers leave their order in the same cycle as the case customer did)

Comments about the service level?

Comments about the time window?

Comments about the tasks?

Comments about costs?