

**UNIVERSITY OF VAASA**  
**FACULTY OF TECHNOLOGY**  
**INDUSTRIAL MANAGEMENT**

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**CONNECTING AIR FREIGHT SERVICES WITH THE ROAD TRANSPORT  
NETWORK**

**Case: FREJA Transport & Logistics Oy**

Master's thesis in  
Industrial Management

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**TIIVISTELMÄ:**

Tämä tutkielma tehdään toimeksiantona FREJA Transport & Logistics Oy:lle. Tutkielman tavoitteena on tutkia, kuinka nykyistä vientilentorahtiprosessia voidaan kehittää DMAIC mallin avulla. Vientilentorahtiprosessi on suurimmaksi osaksi ulkoistettu ja yrityksen omia resursseja käytetty vähäisesti. Tutkimus on rajattu koskemaan vain lentokuljetuksia, jotka suuntautuvat Suomesta Euroopan ulkopuolelle.

Tutkielman teoreettinen osuus on jaettu kahteen erilliseen osaan. Ensimmäinen osa käsittelee liiketoimintaprosessin kehittämistä, Six Sigmaa, DMAIC mallia sekä SCOR mittareita. Toinen osa käsittelee lentorahtia. Lentorahtikonseptia tutkittiin kuuden eri teeman kautta: lentorahdin kysyntä, lentokoneet, kuljetusyksiköt, lentorahtitoimijat, lentorahtikustannukset, ja markkinoiden tulevaisuus. Lopuksi muodostettiin yleinen vientilentorahtiprosessi, joka loi pohjaa tutkielman empiiriselle osuudelle.

Tutkielman empiirisessä osuudessa nykyistä vientilentorahtiprosessia kehitettiin vaihe vaiheelta DMAIC mallin mukaisesti, jotta syyt omien resurssien vähäiseen käyttöön löydettäisiin. Olennaisin syy prosessin tehottomuudelle oli prosessin eri vaiheiden ulkoistaminen ja useiden välikäsien liittäminen prosessiin. Ratkaisu oli hoitaa maantiekuljetus lähettäjältä lähtölentokentälle yrityksen omaa kuljetuskalustoa ja -verkostoa käyttäen. Tulokset osoittivat, että parannellulla prosessilla voidaan vähentää prosessin toimintakustannuksia tinkimättä palvelutasosta. Tutkimuksen tulokset osoitettiin kelvollisiksi DMAIC mallissa luotujen prosessikaavioiden, kannattavuuslaskelmien ja muiden tutkimusta tukevien dokumenttien avulla.

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**AVAINSANAT:** Lentorahti, liiketoimintaprosessin kehittäminen, DMAIC

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**ABSTRACT:**

This master's thesis is made as a commission for FREJA Transport & Logistics Oy. Aim of the thesis is to research how the current export air freight process can be improved with DMAIC cycle. Export air freight process needed improvement because process was mostly outsourced and company's own resources used poorly. Research is limited to consider only export air transports from Finland to outside Europe.

Theoretical part of the research was divided to two separate sections. First section handled the concept of business process improvement, which included such issues as Six Sigma, DMAIC cycle, and SCOR metrics. Second section of the theoretical part considered air freight. Air freight was discussed through six themes: demand for air cargo, aircrafts, transport units, air cargo operators, air freight costs, and future in the market. Lastly a common export air freight process was comprised and explained to set basis for the empirical part.

In the empirical part, process was improved step by step as per the DMAIC cycle to reveal the issues causing the limited use of own resources. Main reason for variation and inefficient use of resources was outsourcing and by that linking number of intermediaries in the process. The solution was to insource the road transportation from the consignor to the gateway airport. Results revealed that operating costs can be reduced with the improved process and still offer evenly competitive service. Results of the empirical part were validated by process charts, profitability calculations and other supporting documentation created during the DMAIC cycle.

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**KEYWORDS:** Air freight, Business process improvement, DMAIC

## 1 INTRODUCTION

Supply chain management is commonly divided to three main activities, purchasing, manufacturing and transportation (Tseng, Yue & Taylor 2005). Transportation is also one of the six drivers of supply chain performance, along with sourcing, inventory, facilities, information and pricing (Shahzadi, Amin & Chaudhary 2013: 53). By moving inventory and products between stages in the supply chain, transportation impacts to supply chain efficiency and responsiveness. (Chopra & Meindl 2012: 45.) Air transportation, which is fastest mode of transport, provides responsiveness due short delivery times but does not provide much of efficiency due the inflexibility and high costs.

Supply chains as well as air freight chains are often long and complicated. What is common factor for almost every air freight chain is the fact that those require different mode of transports (Ritvanen, Inkiläinen, Von Bell & Santala 2011: 114). Multi- and intermodal transports are used to reduce the inflexibility and costs of air transport in supply chains. Because transportation industry is constantly under strong market pressure, level of inflexibility and costs in air freight processes should be assessed and improved respectively. Very efficient way to make air freight processes more competitive is to conduct business process improvement initiatives.

Since the industrial age, organizations have had three options to improve their business performance. First one is to improve workers by increasing their knowledge and developing their skills and making them comprehensively more efficient. Second one is to improve technology and third one is to improve processes. Making improvements in these three areas should always be the core of any improvement initiative. Often when you improve one of these options you will inevitably affect to other options. For example, if you improve a process you must train workers to operate with the improved process. (West 2016.)

## 1.1 Objectives and delimitations

This master's thesis is made as a commission for FREJA Transport & Logistics Oy. The subject in this master's thesis is business process improvement for the export air freight process of FREJA Transport & Logistics Oy.

Research question is formed as:

*Can the current export air freight process be improved with DMAIC cycle?*

Only the export air freight process from Finland was examined. Export air freight process was chosen because 80-90 % of FREJA's air freight shipments are export shipments. Scope of the improvement project was to research export air freight process for shipments between 100 kg/0.4 ldm and 24 000 kg/13,6 ldm, which are transported by road to gateway airports in Europe and flew from there to destinations outside Europe.

Purpose is to find solution(s) that increases the utilization of FREJA's resources in the process. Fierce competition in the market makes it essential to have efficient air freight process. This should be especially emphasized issue since FREJA launched its air freight services only recently. In this thesis, export air freight process is improved with Six Sigma's DMAIC (Define-Measure-Analyze-Improve-Control) methodology. Six Sigma aims at increasing profits by decreasing variation in the process. DMAIC is a known and standardized methodology used in existing processes that need incremental improvement and does not comply with specification requirements. With DMAIC, process improvement is done through five fundamental phases by acquiring detailed data and running statistical analysis for identifying problems. Problems are then eliminated by constructing suitable practices.

The problem in the current export air freight process is that FREJA's core competence is not utilized at all in the process. FREJA is one of the best in the industry to provide international road transports. They have hundreds of trailers and extensive network of part-

ners. They also maintain state of the art IT infrastructure in which the transport management is carried out. Target is to increase efficiency in the process by using FREJA's core competence more actively. Desired outcome is to create a functional and more efficient export air freight process for FREJA Transport & Logistics Oy to ensure competitiveness in the market. From this thesis FREJA will receive clearly defined process chart for the improved process, estimate calculations for cost savings and level of functionality, and proposal for marketing the road feeder services (product of the improved process).

## 1.2 Research methodology

This study is conducted by using qualitative research as the main approach. Data used in the empirical part is gathered from the client organization and its partner organizations and analysed with standardized tools in DMAIC cycle. The starting point for qualitative research is to describe reality as literally and rigorously as possible. Data is gathered by observing the research environment. It is followed by accurate documentation of the observations. The core idea in qualitative research is to concern oneself to the subject comprehensively so that the phenomenon can be understood profoundly in its context. The research subject may be for example a development of real product or process where the quantitative methods cannot necessarily describe the subject as thoroughly as needed. Qualitative research will not limit to only proving already existing assertions but to find and reveal facts. (Kiviniemi 2001: 68; Hirsjärvi, Remes & Sajavaara 2009: 160–161.)

Quantitative research method is also applied in this study. This is because specific tools in DMAIC model require quantified data. Quantitative research method describes and interprets the research subject with numbers and statistics. Quantitative method is usually based on researching different classifications, cause and effect relationships, comparisons and numerical results of phenomenon. (Jyväskylän yliopisto 2015.)

### 1.2.1 Case study and action research

Research methods in this study include both case study and its sub-method, action research. Using case study research requires that a single research subject has been selected in advance and that the research is based on acquiring data from it. Examination of the client organization's export air freight process is the case study of this thesis. This is because the aim of the study is to understand the air freight process, find out how it can be improved and improve it. Case study research strategy belongs to empirical research. It is used to analyse real life subject in its natural environment when the boundaries between the subject and active factors are ambiguous. Basis for a case study is to diversely observe single case and form distinct understanding of its characteristics. It aims to understand the active factors of individual situation and gain understanding of e.g. process, product or service. Even though there is only one research subject, it can include several different events. Questions "why" and "how" are used to describe and understand these complicated events. (Eisenhardt 1989: 534; Yin 2009: 18.)

Action research suits this business process improvement study well since its key objective is to improve subject's functioning and report achieved results. Action research aims at providing precise idea about functioning of a specific object. Desired outcome is to gain solid development and practical changes to the subject. (Heikkinen 2001: 170–171; Bas-kerville & Myers 2004: 329– 330.)

### 1.2.2 Reliability and validity

Measuring reliability and validity of the research is central part of the whole research process. Reliability refers to the repeatability of the research. Repeatability of the research indicates that the research will not provide random results. Validity indicates that the research will measure those issues which was set to be measured in the beginning of the research. It also measures how valid the research is in reality. Research always aims to be as reliable and valid as possible. Value of the research is shown if its results are tenable and can be reliably proved. (Hirsjärvi etc. 2009: 231.)

How reliability and validity of a research can then be measured? There are many ways but one is to conduct the measuring multiple times in the research. Another way is to precisely describe the techniques used in the research and provide detailed explanation about how the results were achieved in practice. By using the DMAIC cycle, every phase of the empirical research is described at length. DMAIC cycle includes several tools and by that the repeatability of the results can be proven. These issues will help to validate the research and confirm the reliability of the research. (Hirsjärvi etc. 2009: 231–233.)

### 1.3 Structure of the report

This thesis was started in October 2016 and it was finished in January 2017. Theoretical material was gathered and written during October and November 2016. Empirical material was gathered continuously during the project and written from November to end of December 2016.

Study is divided to theoretical section and empirical section, which are followed by analysis and conclusions chapter. Theoretical section is further divided to examination of business process improvement and to introduction of air transportation. Examination of the business process improvement concept introduces also such concepts as process and business process, Six Sigma and DMAIC cycle, KPI, as well as SCOR model and SCOR metrics. These concepts are later used in the empirical part. Introduction of air transportation provides insight to air freight industry which will help reader to better understand the export air freight process.

Empirical part starts by background introduction of the case study. This will include information about client organization, reasons for selecting the subject, and introduction of the business process improvement project. In the second phase, the export air freight process is improved with thorough completion of DMAIC cycle. Research is finished by presenting key findings, listing development proposals, and summarizing the results.

Theoretical part of the research was created by studying reliable online publications, articles and books. These were found from university libraries, electronic article databases and electronic libraries. In the empirical part, material was constructed from interviews, enquiries, internal company material, and observations.

## 2 ENHANCING PERFORMANCE THROUGH BPI

Process improvement and enhanced performance are highly correlated. If we improve practices for project risk management, our business performance is enhanced by ability to conduct future projects within budgets. This is because our improved practices make it possible to mitigate the impacts of risks that will lead to over-spending. Another example would be when the process improvement is about defining the test procedures for products, which would lead to reduced number of defects and increased customer satisfaction. This would eliminate the incorrect procedures in product testing and reduce the number of undetected defects. (West 2016.)

In this chapter, the concept of business process improvement (BPI) is handled. Scope of the chapter is to observe business process improvement from commercial perspective. This is done by first describing a process and a business process, which is followed by a general presentation of business process improvement. After this, the concept of business process improvement is supported with issues and methods related to it and the case study. First the concept of Six Sigma is introduced, as well as DMAIC methodology that is essential part of Six Sigma process. This section is followed by a presentation of the Key Performance Indicator (KPI). Lastly, the Supply Chain Operations Reference (SCOR) model and its metrics are discussed. These specific issues and methods are later used in the empirical part of the thesis.

### 2.1 Definitions of process and business process

Work has been broken down into small phases since the industrial revolution. Back then these small phases were the base of an assembly line. Now the process concept is much more complicated since consumers are more price- and quality-conscious. (Flanigan & Scott 1995: 5.) Process is constituted from a group of recurring activities as well as resources needed to execute those activities. The desired result is an outcome where inputs have been turned to outputs. (Sahi 2016.) Process is a totality of connected events and

assignments, which starts from a need of something and ends when the need is fulfilled (Logistiikan maailma 2016d).

It is necessary to define clearly the difference between a task and a process. Tasks are the activities executed in a process. For example, if you are going to make chicken noodle soup, the process is the whole making of the soup while tasks include finding a recipe, purchasing ingredients, boiling the water, mixing ingredients, adding spices, and cooking the soup until its ready. A process includes multiple tasks which are done in sequence. These tasks are things that you add to input. Input can be anything that you need to start the process. Things that will be produced in the process are outputs. (Flanigan & Scott 1995: 6.)

In addition to inputs and multiple tasks in a process, a business process will also include many different people and departments (Flanigan & Scott 1995: 6). A business process is constituted from a complete set of transactional and collaborative activities, which are dynamically coordinated. Business process can also be described as performance of a set of related tasks aiming at achieving a specified commercial outcome to a market or a customer. Business processes always have beginning and end, as well as specified inputs and outputs. (Forster 2006.)

Conducting a business process aims at delivering value to customer. This is the case whether the business process is focused on the production of physical products or services. (Forster 2006.) The output of the process must be something that the customer values and is willing to pay for. Even if the customer in question is internal and within your company. Customer can be described as anyone whose satisfaction you can affect with your process. Customers use their money to products or services from which they feel they will get the most value of. Value to customer is determined by the relationship of quality and cost. Customer will pay more for your product if they feel that it brings more value to them. (Flanigan & Scott 1995: 17-18, 53.)

Valuable output is created when each task in the process adds value to the next task and output of the process. Straightforward method to check whether each task adds value to the output is to determine if the customer is willing to pay for each task. If they are not, then the task in question is not producing any value in the process. Tasks that add value to the process are essential. Value added tasks often produce physical changes to a product. However, this is not always the case because for example providing customer with a schedule update every week does not physically change the product but is still something that customer is willing to pay for. (Flanigan & Scott 1995: 53.)

## 2.2 Business Process Improvement (BPI)

When the tasks or phases in the process that will not add value to the output are identified it usually leads to a business process improvement initiative. Business process improvement (BPI) aims at limiting or eliminating non-value adding tasks to make the process more efficient. BPI is described as systematic approach for bottom-up and incremental enhancement of current processes to change the way organization does business. (Forster 2006.) While the business environment is changing through technological, political, organizational etc. changes, companies use BPI for adapting to these changes and keeping themselves up to date. Already in 2009 in a Gartner survey BPI was listed as number one priority among the top ten business priorities. Today, BPI is an essential part of process lifecycle. (Zellner 2011.)

It is said that depending on the level of change needed, BPI is basically the product of BPR (Business Process Reengineering), Redesign and Benchmarking. The scope in BPI is narrower than in BPR. (Forster 2006.) BPR is provider of radical improvement when BPI is more related to incremental improvement. These can also be classified as two different subsets of redesign. (Zellner 2011.)

Reengineering projects provide improvements in larger scale than BPI. Because of that it is common to think that organizations should aim to BPR initiatives rather than BPI initiatives. However, one should notice that while the payoff increases with bigger project scope, similarly the potential for risks grows. It is difficult to handle large improvement projects especially if the management is not fully aware of the bottom-line issues. That might lead to a situation where the project involves a lot of people but nobody knows clearly how things should be done. This will easily result in unsuccessful projects or half-implemented improvements. (Flanigan & Scott 1995: 4.)

It is possible to combine these two process redesign approaches by choosing the best practises from those. As Flanigan & Scott (1995: 4) points out BPI and BPR are quite similar and have quite a lot in common:

- Requirement for participation
- Use of customer as the starting point
- Requirement for measures and training
- Taking a process view
- Working in both service and manufacturing business
- Improving business processes positively to create better products and services.

(Flanigan & Scott 1995: 4.)

Typical idea for BPR is that it questions if the process examined is even needed and gets rid of it if not. Whereas typical idea for BPI is that the process examined will be improved instead of getting rid of it. (Flanigan & Scott 1995: 5.)

Commonly process improvement project first starts with an orientation to the subject, then the tasks are divided, project plan constructed and tasks executed accordingly. Desirably the project ends to an achievement and conclusion. It does not matter what kind of improvement is in question, planning and tracking of tasks as well as resources must be done thoroughly. In addition, there often are several issues that must be approved by the management. (Berman 2014: 271.) These issues commonly include:

- Budget requirements

- Technology, facility and equipment impacts
- Needs for training
- Potential risks
- Benefits for organization (Abudi 2011).

Project managers and other responsible persons in BPI projects must be familiar with the practices of project management. Leading process improvement projects might require even more advanced skills than most projects. (Berman 2014: 271.) Abudi (2011) notes that BPI projects have heavy impacts to entire business and it requires great amount of time to absorb its affects. These significant impacts result from the challenge of acquiring sufficient resources to the project at the right time and from controlling the many moving parts in it. (Abudi 2011.)

Improvement work is characterized with cyclical nature. This means that the cycle will be formed from different phases, assessing the current situation, planning and creating improvements, implementing these to processes and measuring if the goals set at the beginning are met. If those are not met, then the cycle starts again. Even if those are met, cycle might be started again to ensure continuous improvement. This kind of cyclical nature should be applied to whole organization because it can provide significant competitive advantage when organization is up to date and constantly driving for innovativeness. (Andersen 2007: 6.)

Andersen (2007: 5) suggests a list of elements that should be included to BPI framework. First thing to consider is the overall priorities of the organization. This is determined by the stakeholders and strategy of an organization, which also provides information about the areas where organization needs to excel. A road map for BPI will indicate the immediate improvement needs in processes as well as the needs for improvements in long-term. (Andersen 2007: 5.)

Another essential issue is to be familiar with the organization's current business processes. Understanding of the current processes is the platform where the improvement

projects are based. (Andersen 2007: 5.) To improve a business process, following issues should be known: inputs of the process, tasks within the process, work flow between the tasks, value created in the process, outputs of the process, and measurements of the process (Flanigan & Scott 1995: 47).

With a performance measurement, it is possible to study which of the processes need improvement. Measurement provides precise information about the current process and helps track improvement. (Andersen 2007: 5.) However, some of the companies and managers do not want to use measurements. This can be caused by a lack of knowledge of what and how to measure. It is also possible that employees distrust and fear measurements. Another reason might be that the results of measurements are not shared to everybody in the organization. Many people make the measuring process much more challenging than it need to be. (Flanigan & Scott 1995: 32, 35.)

To simply describe a common instruction for measuring, you must always improve what you measure and measure what you improve. It won't provide any valid results if you improve your process and measure your product. (West 2016.) In other words, you should measure what is important to the customer, measure things that you would like to improve, execute the measuring by using common terminology, and remember to measure logical outcomes of the process (Flanigan & Scott 1995: 35). In addition, Forster (2006) argues that companies should use competitive priorities as merits to compete in the market. Forster points out that for the assessment of all business activities, the most common basic measurements are quality, time, cost, and flexibility. (Forster 2006.)

To find out which phases of your process add value to the output Flanigan & Scott (1995: 64) suggest to determine what would happen to the output of the process if some specific phase or input is removed. If the phase or input is removed and nothing happens to the output, then it has been a non-value adding phase or input. Respectively if the output changes, then the phase or input adds value to the output. Before removing the non-value adding phase or input, it is crucial to understand why it was put to the process at first

place. If you do not understand it, then removing it might cause the process to become non-functional. (Flanigan & Scott 1995: 64, 73.)

To select the best solution for improvement one should gather every solution available and assess them. A rating chart is excellent for this matter. First you choose criteria for the chart. Criteria could include for example, probability of solving problem, ease of implementing, and value to customer. Then you need to have proper measurements to compare these to each other. Finally, you put up a scale (e.g. 1-5) indicating the rating of each criteria and helping you to select the most preferable solution. (Flanigan & Scott 1995: 84.)

Today the question is not whether we must improve, the question is how much and how quickly we can improve (Andersen 2007: 3). Organizations are constantly facing changes in their operational environment. It is not enough to come to terms with changes. If company wants to succeed, it must be able to incorporate and take advantage of the change. Executing your processes faster, cheaper and better while increasing customer value is a core issue in every business (Flanigan & Scott 1995: 10, 104). That is why there is variety of choices available regarding the approach to use in business process improvement. It is possible to select single approach or use tailored combination of approaches. These approaches can be for example benchmarking, SAM framework, weak points analysis for business process and improvement (WABPI), TQM, or Six Sigma. (Zellner 2011; Siha & Saad 2008.)

### 2.3 Six Sigma

Delivering tangible business benefits to the bottom line through operationalizing Total Quality Management (TQM) into a project-based system. This is how Oakland (2014, 296) describes Six Sigma. Knowles, Whicker, Femat & Canales (2005) described Six Sigma as an approach to performance and quality improvement, which achieves its results by combining highly trained operatives, thorough process improvement methodology and

bottom-line focus. Six Sigma has been defined in multiple ways by different authors, as well as several authors and organizations has argued about the significant financial benefits that comes along with it. There is also extensive offering of content, deployment and training material available regarding Six Sigma. (Beercroft, Duffy & Moran 2003: 197; Knowles etc. 2005).

### 2.3.1 History and definition

Six Sigma is a registered trademark of Motorola (Beercroft etc. 2003: 197). However, Six Sigma originates already from 1800s when Carl Frederick Gauss introduced the concept of normal curve. It was first used as a measurement standard in 1920s and it was Walter Shewhart who indicated the point for requirement of correction in a process, which was three sigma from the mean. Yet Motorola's Bill Smith was the first to use the term 'Six Sigma' while Motorola began the pioneering of Six Sigma from the mid-1980s onward. (Van Bon & Verheijen 2006.) Pioneering was started due the ever-increasing global competition and the fact that measuring defect rates as parts per hundred was not good enough in the global platform. Motorola shared its Six Sigma Quality program to others after winning the Malcolm Baldrige National Quality Award in 1988. (Andersen 2007: 204.)

For a long time Six Sigma was concerned only as a methodology for operations and manufacturing industries. Now Six Sigma is used in over ten industry sectors and some of the biggest companies that have implemented it are Ford, LG Philips, Nokia, Boeing and Citibank. (Van Bon & Verheijen 2006.) This is because these commercial companies share a common goal, to produce goods or services and make profit. (Oakland 2014: 297).

Organizations will face similar problems when their organizational goals are alike. One common problem is that organization's management tends to get what it measures, meaning the people's tendency to respond in the way they are measured. For example, if the measuring is throughput based, the work-in-progress and finished goods inventory might

increase while cash and working capital decreases. The way Six Sigma solves this problem is by viewing processes as chains of independent events. Events are subjects to variation and finished products and services accumulation of variation. The core is to focus on factual data and metrics, as well as identifying and eliminating variation in processes. (Oakland 2014: 297-298.)

Six Sigma does not just focus on the average performance it also considers the cause of 'hidden-factory', variability. Hidden-factory is showed to customer when a business is not getting it right the first time. This will lead to such issues as scrap costs, repair costs, write-offs to customer, and concessions for late deliveries. For example, supplier promises that it delivers 10,000 machine parts in 7 business days. Due some mistake 2,500 parts are delivered in 10 business days instead of seven. Such 'minor' mistake has huge impact like increased delivery costs, reduced profit (since not meeting the agreed schedule), possible rework costs (since the quality might decrease when order is fulfilled in a rush), loss of confidence from the customer, and potential loss of new customers associated with the offended customer. (Beercroft etc. 2003: 197.)

Six Sigma is a measurement-based strategy focused on reducing variation and improving processes through Six Sigma improvement project applications. The goal is to increase profits, which is achieved by eliminating defects, variability and waste that negatively affects to customers. Six Sigma aims to improve processes into phase where the variation is very minimal causing only 3.4 defects in million opportunities (dpmo). In most companies, the average dpmo is 6,200. Dpmo should not be measured from the characteristics of the whole unit but in Critical to Quality (CTQ) characteristics. Six Sigma as a term relates to situation where you have 99.99 percent confidence of achieving specified results. In the case above, 3.4 defects in million attempts would mean only three defects in every 100 shipments of 10,000 machinery parts. A defect can be anything that is not included to customer specifications. (Van Bon & Verheijen 2006; Beercroft etc. 2003: 197; Siha & Saad 2008.)

### 2.3.2 Philosophy and methodology

Philosophy behind the Six Sigma targets to variation reduce in the business while making decisions through accurate data and customer-focus. The Six Sigma framework is used to operate the whole organization, not just process improvement projects. It requires discipline and change in organizational thinking to more data-driven approach to adapt quality measures to every process, product and service of an organization, and to eliminate defects. (Van Bon & Verheijen 2006.)

One of the characteristics of Six Sigma is to train technical leaders to manage the Six Sigma projects and apply Six Sigma techniques (Van Bon & Verheijen 2006). Six Sigma Master Blackbelts maintain the highest proficiency and are responsible for planning the structure and resources for the project. They also support, mentor and train Blackbelts who often work full time with Six Sigma projects for example as project managers. Blackbelts can use very advanced techniques and act as technical experts in the projects. (Knowles etc. 2005; Beercroft etc. 2003: 201.)

Greenbelts are less trained than Blackbelts and they can apply smaller selection of techniques. Executive Sponsor is responsible for ensuring transparency and open dialogue in the project, for example by maintaining communication between parties, securing funding and rewarding the project team. Deployment Champion is responsible for coordinating the project, for example by preventing conflicts and setting the operational vision. Project Champions are usually the owners of the process, responsible for issues that Six Sigma aims to prevent. Their activities include for example solution approval and tollgate reviews. (Beercroft etc. 2003: 201-202.)

The Six Sigma techniques that the technical leaders apply in the projects are quality improvement tools that Six Sigma has gathered together. The list of these tools is very extensive and it is one of the strengths of Six Sigma. The list includes such commonly used tools as brainstorming, Cause and Effect, Control Charts, FMEA (risk assessment), Out-

of-the-Box Thinking, Process Mapping, Document Control, and Flow Charting. (Van Bon & Verheijen 2006.)

Methodology in Six Sigma is built from different quality tools and data-driven analysis. The use of methodology is divided to phases where each phase is linked to the following one. If one or more phases or tools are not used, it will negatively affect to the outcome of the project. Six Sigma management system uses phases so that attention is paid disciplinary to every issue, and that the defects are fixed properly. (Beercroft etc. 2003: 199.)

There are two projected Six Sigma improvement methodologies, and one that is more of a tailored approach. The most known and standardized methodology is a problem-solving roadmap DMAIC (Define-Measure-Analyze-Improve-Control). It is used for existing processes that need incremental improvement and are not responding to specification requirements. Second one is used for designing processes and products with data driven quality strategy and is called DMADV (Define-Measure-Analyze-Design-Verify). The third one DFSS (Design For Six Sigma) is related to DMADV but is not that much of a defined methodology than it is an approach. DFSS is defined differently among organizations and it does not provide clear recognizable phases. (Van Bon & Verheijen 2006.) Further, it is focused more on creating new products and completely re-designing processes. (Andersen 2007: 206.)

### 2.3.3 Process of Six Sigma: The DMAIC methodology

The Six Sigma improvement model DMAIC is the basic improvement process in the Six Sigma concept (Andersen 2007: 204). DMAIC improves process performance with advanced strategy and disciplined methods. These are used for applying precise data and statistical analysis for identification of errors and for finding practices to eliminate those. (Oakland 2014: 296.)

DMAIC improvement cycle is divided to five fundamental phases: Define, Measure, Analyze, Improve and Control. It is an enhanced version of the Deming's cycle (Plan-Do-

Check-Act cycle) for continuous improvement. (Oakland 2014: 296.) Define phase aims to understand the process in question from perspective of suppliers, operators and customers. Measure phase focuses on measuring the current performance. Analyze phase seeks to find the contributors causing variation and poor performance. Improve phase defines, tests and operationalizes improvements, which are created based on the outputs from previous phases. Control phase make sure that changes made are firmly established, successful, appropriate, and transferred to organization's other processes. (Knowles etc. 2005.) Phases of DMAIC cycle are presented in the figure 1 and described more closely below.

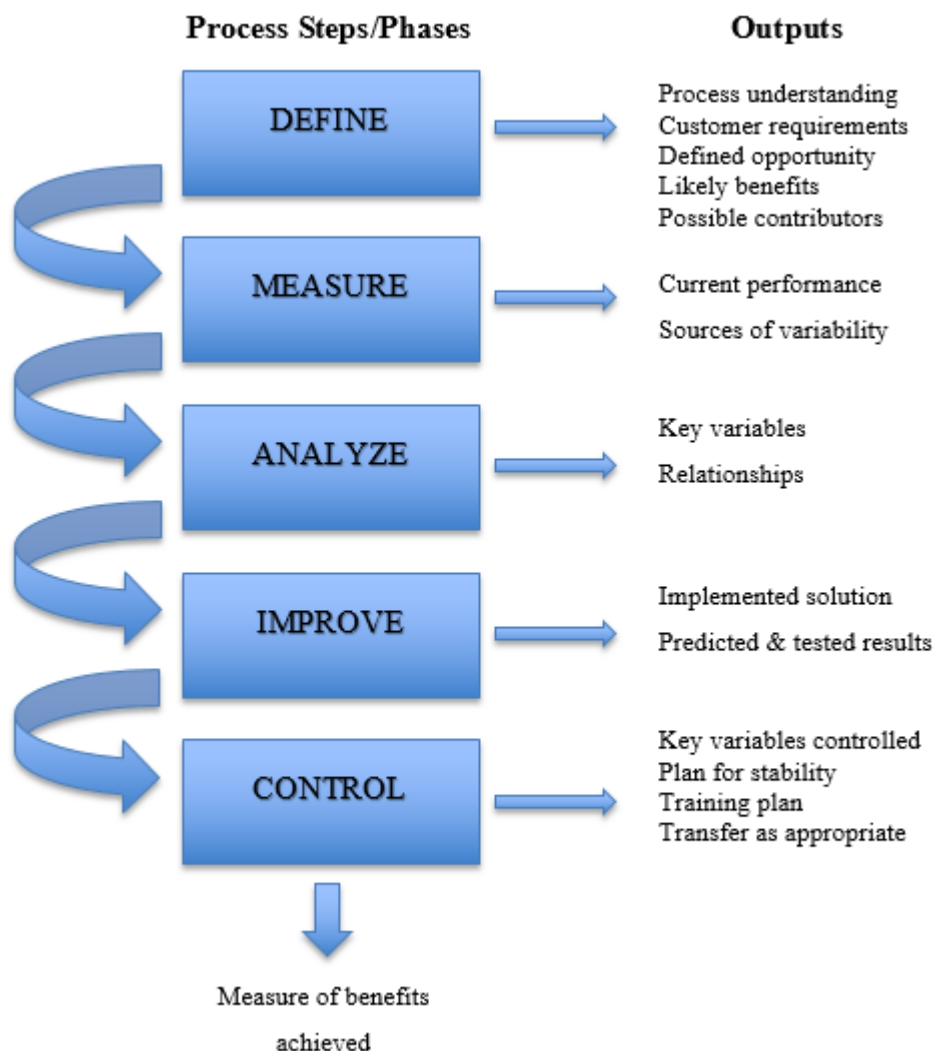


Figure 1. The Six Sigma DMAIC process (Knowles etc. 2005).

In the *Define* phase, project's objectives, focus, and desired benefits are defined. Another important task is to define the business process which causes the problems. The process is defined by mapping the process flow with a process chart including inputs, outputs, controls and resources of the process. (Oakland 2014: 297; Andersen 2007: 205.) This phase can include many different tools and techniques such as SIPOC diagram, project charter, VOC (voice of the customer), flow diagrams, and brainstorming (Knowles etc. 2005).

*Measure* phase includes activities to collect data about the performance of the process, which are further used to understand the capabilities of the process and limiting the range of potential causes for the occurring problems. The aim of this phase is to define proper metrics for the process, construct a collection of performance data, display the data so that variation in the process can be understood, and construct a calculation of process capability. (Andersen 2007: 205.) Tools and techniques that can be used in this phase are for example data collection formats, control charts, FMEA, Pareto chart, and sampling (Knowles etc. 2005).

In the *Analyze* phase the main idea is to better understand the problem in question (Andersen 2007: 205). This requires that the gap between the current and target performance is analysed, problems prioritized, and root causes for the problems identified (Oakland 2014: 297). Activities in this phase include creating a more detailed process map, producing a cause-and-effect understanding, and verification of the causes that has the most significant impact to the process. Tools to use in this phase could be such as cause-and-effect chart and scatter chart, value-added analysis, detailed process mapping, and hypothesis testing. (Andersen 2007, 205)

To fix the problems in the process and prevent them from recurring, the *Improve* phase generates improvement solutions to meet the required performance and financial goals (Oakland 2014: 297). Preferred outcomes are constituted from a risk analysis and cost-benefit analysis for the suggested solutions. The improvements are also implemented in this phase. This includes implementation plan, pilot implementation, and implementation

of the solution. Tools and techniques in this phase include control charts, force field analysis, project management techniques, stakeholder analysis, and brainstorming. (Andersen 2007: 205-206; Knowles etc. 2005.)

In the *Control* phase, the sustainability of the implemented improvements and solutions is confirmed (Oakland 2014: 297). The goal is that the solution is made functional and that the process will not take any steps back in the future (Andersen 2007: 206). Both the standards of operation and standards of performance will be documented. Operation standards for example with ISO 9000, and the latter ones managed with statistical process control (SPC). (Oakland 2014: 297.) In addition to the documentation of the result, a training plan and a plan for sustaining the improvement must be created along with a documentation of the whole project. Tools and techniques commonly used in this phase include process capability calculations, control charts, and standardization. (Andersen 2007: 206.)

Like the DMAIC cycle indicates Six Sigma organizations need to understand their customer requirements, identify core-critical processes that add value to customer, involve all employees, ensure continuous improvement, and be very responsive to change. When organization fills these requirements, a proper six sigma strategy can be implemented. Characteristics of such strategy include, whole organization training, leadership involvement, communication, selection of suitable improvement tools, as well as sustained and controlled improvement. (Oakland 2014: 298.)

#### 2.4 Key Performance Indicator (KPI)

One fundamental principle in management is performance measurement. Like known management consultant Peter Drucker has stated:

It is not possible to manage what you cannot control and you cannot control what you cannot measure! (Weber & Thomas 2005).

Through performance measurement the gaps between current performance and desired performance can be identified. It also indicates the level of progress towards closing the gaps. To find and choose exactly the correct place for performance improvement, key performance indicators (KPI) must be selected and used. (Weber & Thomas 2005.)

KPIs are the most important set of measures in organization. Use of KPIs will significantly affect the current and future success of an organization. (Parmenter 2010: 4.) Parmenter's research from both public and private organizations has revealed seven characteristics of KPIs:

- KPIs are nonfinancial measures
- Measured frequently
- Acted by the senior management team and CEO
- Indicate explicitly what action is required from personnel
- KPIs are measures that tie responsibility to all organizational layers
- Impact significantly
- Encourage organization to take correct actions. (Parmenter 2010: 6.)

The lack of knowledge about what a KPI is has led to a situation where several company utilizes wrong measures as their key performance indicators. It is surprisingly rare occasion when an organization monitors their true KPIs and not just some measures that are termed as KPIs. This is because there are four types of performance measures and those can be easily confused and mixed inappropriately. Key result indicators (KRIs) provide answers to the question how you have done and refers to the effect of your activities, not the causes. Result indicators (RIs) indicate what you have done and performance indicators (PIs) what you should do. KPIs indicate what you should precisely do to increase performance and achieve specific results. (Parmenter 2010: 1.)

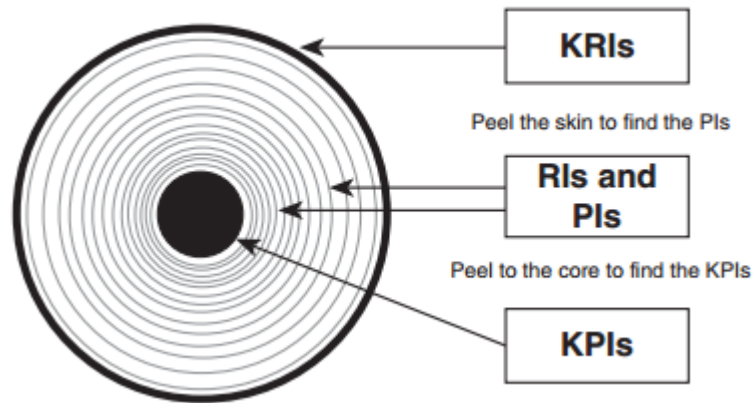


Figure 2. Four types of performance measures (Parmenter 2010).

As the Parmenter's onion analogy figure about the four types of performance measures figure 2 points out, KPIs are the core measures of activities. KRIs are the outside skin, which shows how the onion has been handled during the transportation from harvest to store. They also show the amount of water, sun and nutrients that onion has received and hence its overall condition can be examined from those. By peeling the skin off from the onion we can find more information about it. At first, we will face the RIs and when we go lower layers we will find PIs. When we reach the core, we will find the KPIs, which will offer us information about the root causes for issues we noticed from upper layers. (Parmenter 2010: 2.)

To build a proper comparison to industry standards (individual competitors or previous measurement results), KPIs are used to evaluate the past and already executed performance of an organization. Therefore, an organization should operate as per the set of metrics selected. An example by Krauth etc. (2005) suggests that measures of a logistics service provider should be first categorized in four different categories. These measure categories are effectiveness, efficiency, IT and innovation, and satisfaction. (Krauth, Moonen, Popova & Schut 2005: 240, 242.)

The capability of producing an intended result is measured with *effectiveness*. Effectiveness refers to results that the organization can achieve, concerning the 'outside' of the organization. *Efficiency* concerns the 'inside' of the organization. It measures the results

produced while considering used resources. The ratio between input and output. It reveals how the results are achieved by the organization. *IT and innovation* refers to organization's ability to meet future requirements. Even though an organization would currently be up to date it should still drive for continuous improvement to be in optimal shape also tomorrow. How the organization utilizes IT and innovations tells a lot about organization's long term performance. It is also important that the people in the organization can do their job in some degree of *satisfaction*. Even if effectiveness and efficiency would be at optimal level, the human factors will not necessary be. (Krauth etc. 2005: 242-244.)

#### 2.4.1 SCOR (Supply Chain Operations Reference) model

Well-known Supply Chain Operations Reference (SCOR) model offers a framework for connecting processes, metrics, best practices, and people into a coherent structure. SCOR model is used by thousands of organizations worldwide and it is the most widely used framework for supply chain performance improvement. It is used to compare, determine and evaluate supply chain activities and their performances against other organizations or within an organization. With correct use, it improves effectiveness in supply chain management, in technology, and in related supply chain improvement activities while supporting communication among supply chain partners. (Supply Chain Council 2010.)

SCOR model was developed by Supply Chain Council (SCC), which was established in 1996 by 69 world's leading organizations. This included such organizations as Procter & Gamble, 3M, Texas Instruments, Rockwell Semiconductor, Lockheed Martin, Compaq and Bayer. (Bolstorff & Rosenbaum 2011: 10.) Nowadays the organization maintaining the SCOR model is known as APICS SCC, which was established in 2014 through a merger between APICS and SCC (APICS SCC 2016).

SCOR model suggests that each organization is constituted from five components in which the supply chain activities are based. These integrated interorganizational processes are *plan, source, make, deliver* and *return*, which define supply chain management

from the supplier's supplier to the customer's customer. (Lai, Keehung, Ngai & Cheng 2002: 442; Bolstorff & Rosenbaum 2011: 10)

One of the characteristics of the SCOR model is that it includes three level of process detail. Number of supply chains, their performance measures and competitive requirements are described in *Level 1*. *Level 2* determines the formation of planning and execution strategies in material flow by using standard categories like make-to-order. Required business processes and system functionality for transacting purchase orders, sales orders, work orders etc. are defined in *Level 3*. There are also levels 4 and 5 for SCOR model. *Level 4* is used to detail the process of implementing improvements. It is not included into SCOR but should be defined by the organization itself. *Level 5* process detail has been used by the most advanced users to describe software configuration detail. (Bolstorff & Rosenbaum 2011: 12.)

#### 2.4.2 SCOR metrics

It goes without saying that transportation companies have important role as part of the supply chain to deliver the right product with right quantity and condition along with right documentation to the right place at the right time cost-effectively. Especially challenging task is to maintain affordable operating costs since supply chains are increasingly involved with global customers, rising labor rates and freight prices, regulatory demands, increasing competition and technology development. Diagnostic SCOR metrics provide measures that help organizations to control supply chain performance, for example customer satisfaction and costs. SCOR metrics should be combined with supply chain performance attributes to evaluate comprehensively different supply chains, their strategies and processes. (Supply Chain Council 2010.)

There are different ways to identify supply chain performance attributes and utilize SCOR metrics in supply chains. Lai etc. (2002) presents a method, where the five components of supply chain are divided to four measurement criteria. These are supply chain reliability, responsiveness/flexibility, costs, and assets. Reliability and responsiveness/flexibility

criteria concern about effectiveness-related and customer-facing performance measure. This means how well a supply chain delivers products and/or services, and can be measured by for example delivery performance and supply chain response time. Costs and assets concern about efficiency-related and internal-facing performance measures, referring to efficiency of a supply chain. These can be measured with for example total logistics management costs and cash-to-cash cycle time. (Lai etc. 2002: 442.)

Cai, Liu, Xiao & Liu (2009: 515-516) states that most often managers responsible for supply chains select KPIs based on practical experience and objective requirements. However, systematic performance measurement usually requires using of some existing model, like SCOR. They present a measurement system based on SCOR that includes five measure categories: resource, output, flexibility, innovativeness and information. (Cai etc. 2009: 515-516.)

The original categorizing of supply chain performance attributes in SCOR model was done by Supply Chain Council. They determined five core supply chain performance attributes that are Reliability, Responsiveness, Agility, Costs, and Asset Management. Reliability (a customer focused attribute) refers to the ability to execute operation as expected, focusing on the predictability of the process outcome. The speed of performing tasks is described by the responsiveness attribute (a customer focused attribute). Ability to respond to a change and external influences are described by the agility attribute (a customer focused attribute). Cost of operating the process is described by the cost attribute (an internally focused attribute). Cost attribute is constituted from material costs, labor costs, and transportation costs. Ability to efficiently utilize organization's assets is described by the assets attribute (an internally focused attribute). Managing assets in a supply chain includes activities like outsourcing, insourcing and inventory reduction. (Supply Chain Council 2010.)

There are three levels of predefined metrics in SCOR. Level 1 metrics are known as key performance indicators and strategic metrics. The overall health of the supply chain is

defined and diagnosed by level 1 metrics. It is possible to define realistic targets to support organization's strategic objectives by benchmarking level 1 metrics. Level 2 metrics assist in indicating the root causes of a performance gap for a level 1 metrics. This is because level 2 metrics serve as diagnostics for the metrics in level 1. Diagnostics for level 2 metrics are level 3 metrics. (Supply Chain Council 2010.)

It is called decomposition when the analysis of performance is done through all the three levels starting from level 1. This activity helps to find the processes from the supply chain that needs to be studied further. Like the process elements, many metrics are also hierarchical in the SCOR model. Level 1 metrics are based on the lower level calculations. Level 2 metrics are usually linked with a narrower subset of processes. An example of this could be Delivery Performance, it is based on calculation of the total number of products delivered on time in the right place with the right quantity. Additional metrics would measure the variation between plan and performance, like correlation between the commit date and request date. (Supply Chain Council 2010.)

There are some critics towards the SCOR model measurements and its limitations for performance evaluation in supply chains. Cai etc. (2009) have researched that the usage of measures in supply chain context is too broad. Meaning that there are too many individual measures used. For example, there are 39 different indicators related to costs and 35 indicators related to quality. Applying such amount of measures creates lots of information and selecting the most valuable information to obtain proper improvement strategies is very difficult task. In addition, even if the SCOR model does provide cause-effect relationships between the selection of organization's goal-oriented KPIs, it still lacks the ability to provide clear cause-effect relationships among hierarchical and multiple individual KPIs. SCOR measures cannot create basis for quantitative analysis of complicated interlaced relationships. (Cai etc. 2009: 513.)

In supply chains, most of the KPIs have tangled cause-effect interaction and are correlated, which indicates that the process of KPI accomplishment is very interactive and

recurring. Due for example limited resources and incomplete information, it is not unusual that when accomplishing one KPI it causes additional effort and costs for accomplishing other KPIs. These correlated relationships can be classified into three categories. First is a parallel relationship where the efforts to accomplish two KPIs are not related and hence these are independent of each other. Second is a sequential relationship where attempt to accomplish a KPI leads to extra cost to another KPI, hence these have simple cause-effect relationship. For example, accomplishing a KPI for customer satisfaction requires extra effort and expense if the accomplishment of a KPI for manufacturing costs is under strong effort. Third class is a coupled relationship where KPI accomplishment attempts are dependent on each other, like attempts to achieve manufacturing flexibility and logistics flexibility. (Cai etc. 2009: 515-516.)

The bottleneck in SCOR model is generated by assuming that KPIs are uncoupled. This harms the process of accomplishing critical KPIs and further improving overall performance. Even though SCOR KPIs are excellent in serving as communication tools and describing business operations, they create problems when aiming at achieving several supply chain performance goals and allocating resources efficiently. (Cai etc. 2009: 513.)

### 3 AIR TRANSPORTATION

One-third to two-thirds of logistics costs are constituted from transportation. In addition, transportation costs produce approximately 10 to 20 percent of a product's price that is sold in Europe. (Farahani, Shabnam & Kardar 2011: 109.) Transportation is one of the main and most visible components of logistics. If you would make a survey in a mall and ask people about the definition of logistics, most of the answers would be related to transportation. (Waters 2009: 404.) In this case, transportation means the physical movement of goods and products. It also includes directly related handling activities of goods and products. Target of transportation is to provide transports of goods to the right place, at the right time, at the appropriate condition, and with optimized costs. (Ritvanen etc. 2011: 106.) As Waters (2009: 404) states: "Transport is responsible for the physical movement of materials between points in the supply chain." (Waters 2009; 404.)

Air transportation means moving of goods and passengers by air. Air transportation is chosen as the mode of transport when the objective is to minimize transit time and gain savings and operational benefits in larger scale. Unit price is highest in air transportation among the mode of transports. But when you have the urgency, need of secure, or distant place to deliver air transportation might be the only solution. (Logistiikan maailma 2016e.)

This chapter handles issues related to air cargo transports. Passenger transports are irrelevant for the research so they are not included to this study at all. Chapter is divided to two phases. First phase examines the concept of air freight. This section includes such issues as demand for air cargo, aircrafts, air cargo operators, transport units, air freight costs and future in the market. The second phase introduces a common export air freight process. This will later give the basis for the empirical part where the client organization's export air freight process is improved.

### 3.1 Air freight

To complete supply chain activities, many industries require air freight transports (Tseng etc. 2005: 9). Air freight is significant factor for many industries in improving customer service (Karhunen, Pouri & Santala 2004: 291). This is the case in situations where delivery speed is emphasized and where value per weight or dimensions is high for the shipment (Tseng etc. 2005: 9). Characteristics of air freight are speed, reliability and high freight rates. In addition, size of aircraft limits the quantity, dimensions and weight of shipments. (Karhunen etc. 2004: 291.) However, due the speed and reliability of air freight it is today increasingly important component in modern supply chains and a very common way to move products worldwide (Sales 2013: xxii).

Some argue that the first air cargo operation occurred in 1911 in India where 6,500 pieces of mail was transported for five miles. Eight years later IATA (International Air Traffic Association) was established by six European airlines. This was the start for the development of interline reservations and standardized tickets. World War II provided aviation industry with large transport aircrafts, skilled pilots, jet engines and radar. (Wood, Barone & Murphy 2002: 169-170.) In 1950s, large aircrafts had low load factors, jet aircrafts constantly increased their capacity and freight rates were quite low. Back then, airlines started to see the potential of air freight. The final breakthrough was the release of Boeing 747, known as Jumbo Jet. It carried more freight in a passenger flight than any former generation all-cargo jet aircraft. Later the all-cargo version Boeing 747F was released to operate long-haul cargo flights. (Wood etc. 2002: 174, 177.)

Nowadays air cargo is operated in both domestic and international flights. Cargo can be carried in passenger flights in the belly-hold of an aircraft under passenger seats or in the cargo aircrafts in both belly and main-deck in scheduled or chartered flights. (Sales 2013: xxii) The modern infrastructure for aviation is not usually owned by airlines. Airports and terminals are often built and airways controlled by governments. This means that the high fares of air cargo are not produced by fixed costs. Airlines' fixed costs are based on ac-

quiring cargo containers, aircrafts and handling systems. High fares are a product of variable costs that are impacted by maintenance, jet fuel and labour. Shippers can reduce the impact of variable costs with economies of scale since both shipment size and distance highly impacts to the freight rate. (Farahani etc. 2011: 15.)

To make the air cargo business more affordable, many airlines have joined alliances or created joint ventures. This helps airlines to reduce costs and increase both revenues and global reach. (Karhunen etc. 2004: 293; Morrell 2011: 118). Airline alliances have evolved because of regulatory restrictions, which restrict ownerships and market access of airlines. It is very difficult for an airline to gain control of foreign airline due the protection of national interests. (Morrell 2011: 117.) In alliances, airlines agree with each other about cooperation, flight routes and schedules. To improve their customer service, airlines sell both passenger tickets and air cargo services to their own routes as well as routes operated by their alliance partners. (Karhunen etc. 2004: 293.)

Airlines' agreements and alliances can be categorized to three categories, these are Commercial, Strategic, and Equity partnership. Commercial category includes limited code sharing and marketing agreement, where joint venture flights or block space agreements (marketing airline purchases fixed number of seats or cargo space) are operated. Strategic category includes broad marketing agreement and code sharing around the network. Equity partnership includes execution of shared purchases, like aircrafts, and by that investing to each other. (Morrell 2011: 118.)

In addition to the fact that there might be different airlines involved in a single air freight chain, there is also several operators involved. These are for example forwarders, road hauliers and ground service providers. (Karhunen etc. 2004: 293.) It is notable that involvement of many operators in air freight chain slows down the delivery process. This is due several physical movements of cargo and inaptitude of IT-systems. Parties that have solved this problem are integrators (e.g. UPS, DHL and FedEx) who operate the whole transportation chain with their own resources. Today many of these companies use

subcontractors in for example road transports, but they still operate under one IT-system and procedure manual. (Karhunen etc. 2004: 293.)

35 percent of global trade's value is transported by air cargo industry and hence it acts as an important economic indicator for financial analysis. Air freight industry is responsible for providing the modern world with goods and commodities needed to maintain our way of life. However, this does not come without a price since air transportation is responsible for 3 percent of carbon emissions worldwide. Protecting the environment and reducing the global warming is a priority because it affects to our living environment. Therefore, aviation industry has agreed to stop the growth of carbon emissions by 2020 and to reduce the amount of emissions before 2050 by 50 percent. (Sales 2013: xi-xix.)

### 3.1.1 Demand for air cargo

Air cargo is still often considered as emergency service. This is indicated by the fact that in US only 0.1% of ton-mile traffic is carried by airlines. (Farahani etc. 2011: 15.) Further, only three percent of the volume in global trade is operated with air freight services (Sales 2013: 1). This is caused by the inability of air carriers to offer cost-effective services to low value products (Farahani etc. 2011: 15). Cost and availability drives transport customers to use maritime or road transports. A container ship can carry the capacity of 3,000 largest cargo aircrafts or the capacity worth 30,000 belly-holds off a passenger aircraft. (Sales 2013: 1.) The time advantage of air cargo comes visible only when the shipment is delivered on long-haul flights. Otherwise surface transports dominate the freight volumes. (Farahani etc. 2011: 15.)

Factors resulting to demand of air cargo services are for example high-value products, perishable products, inventory reductions and limited marketing periods. Air transport can respond to these needs through its excellence in safety and time attributes. For example, the claim costs ratio has commonly been 60 percent of road and rail transports' ratio in air freight industry. (Farahani etc. 2011: 15; Waters 2009: 416). Use of air cargo services is commonly based on following issues:

- Willingness and ability to pay higher transport costs
- Goods value (e.g. jet engines)
- Urgency (urgent medical assistance, disaster relief freight etc.)
- Life cycle and vulnerability of products (e.g. perishable goods)
- Place of origin for goods
- Density, dimensions and weight
- Hard to reach delivery location (war, natural disaster, famine, poor infrastructure etc.) (Sales 2013: 16.)

Growth of the air cargo industry is generally produced by the market's need of fast deliveries. It can cost millions of euros even in a short period if the spare part needed to ensure functioning of assembly line or flow of oil from oil rig cannot be received quickly. These situations are often solved with air transport. (Sales 2013: xxi, 1.) Increasingly popular Just-In-Time methodology requires just the right number of goods at exactly the right time. It goes without saying that JIT operations will not survive without regularly executed reliable on-time deliveries. (Karhunen etc. 2004: 290.)

A large shipment of goods transported over long distance by sea can take six weeks while same shipment can be delivered by air in few days. It is sometimes more profitable in a long run to choose air option when considering the total cost of ownership and balance sheet. (Sales 2013: xxi.) For example, Finnish Tamglass once delivered whole production line of windshields to its Indian customer by using air transport. Customer said that they will earn back the costs of air transport during the time it would have taken to deliver the whole shipment by sea. Furthermore, Finnish airline Finnair has stated that when you transport by air the money will also fly, meaning that you will receive your payment much faster. (Karhunen etc. 2004: 290.)

Nature of the product is finally the issue determining the need of transport mode (Karhunen etc. 2004: 290). Must-get-there products with high value like computers, mobile phones, valuable machine tools, flowers, pharmaceuticals and fresh food are some of the most common products that can be found from aircraft's cargo hold. To retell strict

regulations and requirements of temperature-controlled environment, it is often wise to choose air transport to maintain effectiveness and freshness of perishable goods. Furthermore, to meet the modern consumer demand of ‘buy today, receive tomorrow’ created by e-commerce, air transport is often the only option. (Sales 2013: xxi, 1.). Figure 3 below shows the world trade commodity group classifications along with their shares of the world trade. Even though 35 percent of global trade’s value is transported by air cargo industry, it still carries less than 1 percent of world trade tonnage (Crabtree, Hoang, Tom & Gildemann 2016).

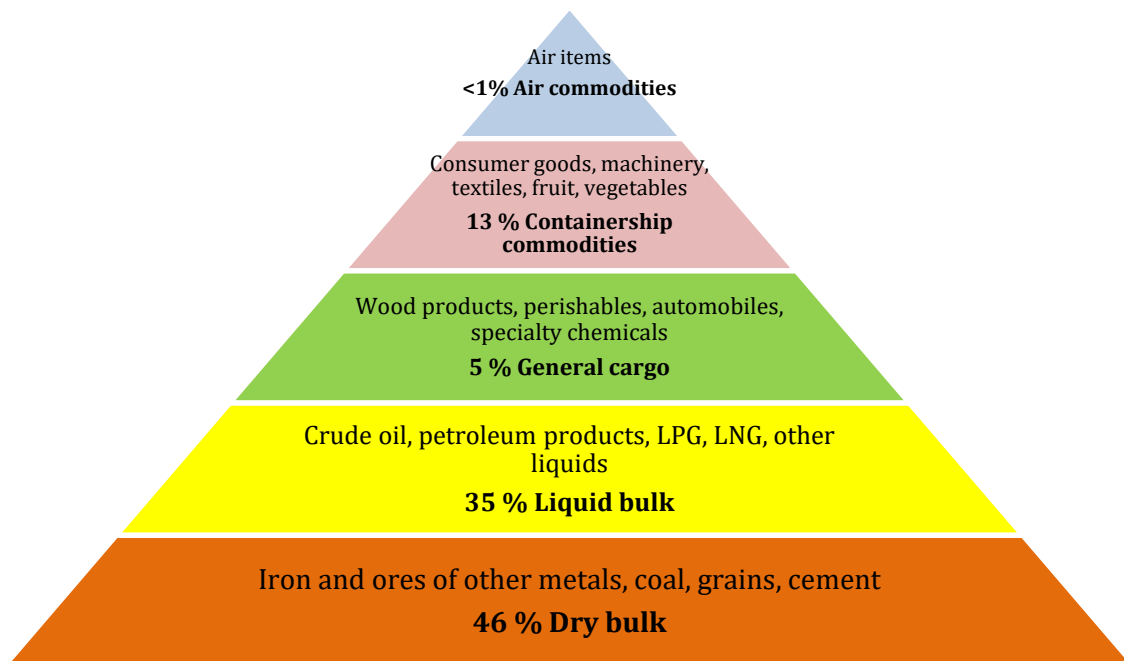


Figure 3. World trade is focused on bulk commodities (Crabtree etc. 2016).

### 3.1.2 Aircrafts

Belly-hold cargo in passenger flights have a portion of 25 percent of all cargo flown. Almost every passenger flight worldwide carries cargo packed in ULD (Unit Load Device) containers and loaded into belly-hold along with passengers’ luggage. Airlines can make 5 to 10 percent of their total sales revenue from cargo operations. 75 percent of all flown cargo is operated with freighters and hence airlines with large fleet of freighters can make up to 50 percent of their sales revenue from carrying cargo. Freighters use

ULDs on the main-deck and in the belly-hold, but they can also carry large bulk shipments. These are loaded through the freighter's nose or large cargo door on the side. Combi aircrafts are a variation of passenger and freighter aircrafts. Combi aircrafts carry freight in their belly-hold and on the main-deck with fewer passengers on board. Aircrafts are further divided to Narrow Body and Wide Body aircrafts. (Sales 2013: xxii, 4.)

Most of the aircrafts in the world are Narrow Body aircrafts. These are typically used in passenger and cargo flights that are operated either domestically or within one continent. Narrow Body aircrafts can be identified from their single aisle design. Freight carrying capability is measured in hundreds of kilograms per passenger flight. Payload capability is affected by weather, route, plane type and number of passengers. Common Narrow Body aircrafts are small Airbuses and Embraers. Like ones that Finnair uses: A319, A320, A321, and Embraer 170 and 190. (Logistiikan maailma 2016f.)

Most of the world's air cargo is carried in Wide Body aircrafts (Logistiikan maailma 2016f). Wide body aircrafts have larger payload and dimensions, and can carry more passengers and freight (Sales 2013: 4). These are designed for intercontinental passenger and cargo flights. Wide Body aircrafts typically have two aisles in the passenger-deck(s). In passenger flights, Wide Body aircrafts can carry 10 to 25 tons of cargo depending on route, plane type, weather and number of passengers. Known Wide Body aircrafts are Airbus A380 and Boeing 747. (Logistiikan maailma 2016f.)

In passenger flights, the most challenging issue is the planning of cargo. Disadvantage is that cargo-door and space available makes it impossible to carry large shipments. Furthermore, these flights are operated per passenger requirements and some of the schedules and destinations will not attract freight. Volume and maximum structural payload can be defined only in the same day when the flight will be operated. This is because routing, weather conditions, number of baggage and passengers (last-minute bookers and missed flights) etc. can vary significantly before the flight. Payload will be constituted from passenger weights, passenger seating density, number of checked baggage and use of lower deck containers. To plan cargo in advance, professionals use a full passenger load as an

estimate and exploit estimate calculations regarding containers and luggage. (Morrell 2011: 132-133.)

Quite the opposite to passenger aircrafts, freighters only carry cargo (Logistiikan maailma 2016f). 90 percent of total revenues of air cargo industry is produced by airlines that operate freighters (Crabtree etc. 2016). Freighters can be containerized or bulk all-cargo aircrafts (Sales 2013: xxii). Capacity in freighters per flight varies mainly between 10 and 100 tons. This is highly dependent on plane model, number of passengers, route and weather. Commonly used freighters are Boeing 747F (figure 4) and McDonnell Douglas MD11F. (Logistiikan maailma 2016f).



Figure 4. Cargolux Boeing 747-800F nose loading (Tinseth 2012).

Combi aircrafts are hybrids of Wide Body passenger aircrafts and freighters (Logistiikan maailma 2016f). These are made to carry both passengers and freight (Morrell 2011: 144). Partition wall separates the passenger cabin from the cargo-hold on the main-deck (Logistiikan maailma 2016f). Cargo is placed on the back of the aircraft while passengers

sit in front of the partition wall, known as the bulkhead (Wood etc. 2002: 181). This enables freight loading into both belly and main-deck of an aircraft (Logistiikan maailma 2016f). Some of the combi aircrafts can also be modified from all-passenger aircrafts to all-cargo aircrafts (and vice versa) quickly within an hour (Wood etc. 2002: 181). However, combi aircrafts are becoming rare and moving off the market. (Logistiikan maailma 2016f.)

Roughly half of all the combi aircrafts and freighters are not originally manufactured as freighters, but instead converted from passenger aircrafts. For example, some airlines favor converted freighters since the airline does not need the benefits like longer range that new freighters bring about. Common lifecycle is that aircrafts operate first 20 years in passenger service, are converted and operate next 20 years in freight service. However, e.g. Chinese government prohibited Chinese airlines to operate over 15 years old freighters. Nor every aircraft can be converted to freighter because of their characteristics (height of cabin, volume/payload ratio etc.), like Airbus A340. In the conversion process, cabin fittings and fixtures as well as unnecessary components are removed. These are replaced with stronger floor, roller tracks, cargo door and other freight conversion components. Windows are changed to metal covers to minimize risk of fire, ease up the maintenance and prevent cargo from sunlight exposure. (Morrell 2011: 134-135.)

Different aircrafts are marked with different numbers and letters by the manufacturers. Letter indicates the manufacturer and numbers the model, like Airbus A350. There can be additional numbers after the original model number, these indicate different aircraft variants like A350-800 and A350-900 from which the A350-900 version is bigger. Combi aircrafts are commonly defined with 'C' and freighters with 'F'. These are attached to aircraft's name like Boeing 747-8F. There are many more letter combinations defining different variants. Further, IATA and ICAO (International Civil Aviation Organization) also have their own type designators for aircrafts. For example, ICAO's designator for Airbus A330-300 is A333. (Morrell 2011: 131.)

### 3.1.3 Transport units

Air cargo can be carried as bulk, on pallets or in containers. Aircraft's loading must be done accurately so that the aircraft will be on balance when it takes off. Densities of freight must be known as well as possible instructions for supporting the freight. Shapes and dimensions of packages must be cleared before loading. Round shape of the aircraft's fuselage and different measures in different aircrafts sets limitations for carried cargo. (Logistiikan maailma 2016g.) That is why almost all air cargo is carried in standardized containers or pallets. Standardized air cargo containers and pallets are known as unit load devices (ULD). There are many different variations of these because each aircraft model can only use ULDs that are designed to fit its shape. Some of the ULDs are interchangeable with different aircraft models. The largest air cargo container reminds sea container and is 20 feet long but much lighter. (Wood etc. 2002: 179.)

ULDs were breakthrough innovation for the use of intermodal transports. Those are usually made of aluminium which ensures the lightness but makes them fragile. (Sales 2013: 36.) ULDs can last for 15 years, but that rarely is the case since those are handled roughly to reduce the time aircraft spends on land. (Sales 2013: 67.) ULDs enhance and ease the cargo handling, protect the valuable cargo, enable the use of standardized handling equipment, and makes it possible to maximize the use of cargo capacity in aircrafts (Logistiikan maailma 2016g; Sales 2013: 67). ULDs can be locked to aircraft's internal structures to prevent any movement from occurring during the flight. (Logistiikan maailma 2016g.)

Container ULDs can be in shape of rectangle, igloo or rectangle with tapered bottom corners (also called loading devices). There is also specific ULD containers designed for example with racks to carry garments, or with features to enable use in temperature-controlled or livestock transports. (Wood etc. 2002: 179.) Some of the biggest integrators have designed their own ULDs to enhance handling operations in their hubs (Morrell 2011: 146). Flat platforms used in air freight and made from aluminium or wood are called ULD pallets. (Wood etc. 2002: 179; Morrell 2011: 145). Cargo is placed on pallets and bounded with nets. (Wood etc. 2002: 179.) Container ULDs are also covered with

nets and sheets (plastic) before loading them into plane. Both pallets and containers are tightly packed with variety of cargo to reach the maximum density and economic benefit. (Sales 2013: 67.)

Every ULD is individually registered and hence can be tracked globally. (Logistiikan maailma 2016g.) IATA has introduced a numbering system where different ULDs can be recognized from their three-letter code, specific set of digits and IATA airline code. (Morrell 2011: 145.) Types of ULDs and their suitability to aircrafts are also described with combination of letters 'L' and 'D' and with number after it. For example, lower deck container is called AKE LD3, where LD3 denotes that it is contoured half-width container suitable for example Boeing B777, B787 and B747 and for wide-body aircrafts of Airbus. (Sales 2013: 67.) In figure 5, AKE LD3 containers are unloaded from the JAL B747-400. 'A' is symbolizing that it is certified structural container, 'K' denotes its dimensions and 'E' its shape (no forklift slots). If the third letter would be 'N', this would mean that the ULD is designed with forklift slots. (Morrell 2011: 145.)



Figure 5. LD3 containers being unloaded from the front cargo hold (Wikipedia 2016).

#### 3.1.4 Air cargo operators

It is rare that a customer books an air freight service directly from an airline. There is usually at least a forwarder involved. Only in a case where customer wants to deliver a large special shipment and needs charter service for it, the shipper books the service directly from charter airline or charter broker. (Sales 2013: 8.) Operators provide variety of services depending the needs of the customer. Customer can choose how quickly it wants the shipment to be delivered and what additional services it is ready to attach. (Wood etc. 2002: 180-181.)

Example of typical service offering includes the most expensive '*first-class*' service designed to priority and time-critical shipments with one to two days' transit time. In this class, operators use the fastest available connection to fulfil the service. The more affordable '*second-class*' is designed for standard shipments where operator can bit more loosely arrange the transport. This class offers delivery time of three to four days. The most affordable '*third-class*' is designed for economy shipments literally meaning that it is the most economical option. This class offers the longest transit time, five to six days from airport to airport not including the road pick-up and delivery. (Sales 2013: 6.)

Operators in air freight services can be divided at least to five different groups. These are, combination carriers, all-cargo carriers, courier and postal companies, charter airlines and freight forwarders. (Sales 2013: 2-3.) In this study, integrators are included to all-cargo carriers. Air cargo industry yet includes many more operators, like GSSAs and GHAs, and some of these are briefly introduced in the Export Air Freight Process section of this chapter.

Airlines that carry both passenger and cargo on regular schedule are called *combination carriers* (Sales 2013: 2). Combi is generally used term in logistics to describe a transport mode that carries both cargo and passengers (Lowe 2002: 44). This can either mean that

the airline carries cargo in its belly-hold on passenger flights (e.g. Norwegian) or that in addition it also has freighters in its fleet (e.g. Lufthansa and Cathay Pacific). (Sales 2013: 2.) Most of the airlines worldwide are combination carriers except some low-cost carriers (e.g. Ryanair) (Morrell 2011: 77).

It is profitable business for combination carriers to sell the extra space in belly-hold to forwarders and other shippers. However, when the passenger flight, mail and express shipment peak is on like at Christmas, belly-holds of passenger aircrafts are almost fully booked and hence cargo shipments can get 'bumped'. This means that cargo shipments will be re-planned to some other later flight, which increases the transit time and risk of complications. Effective but expensive way to balance the flow of passenger and freight for economical or seasonal reasons is to operate freighters. (Wood etc. 2002: 181.)

Only major airlines have freighter flights along with their belly-hold cargo flights. There is three common reason for an airline to operate freighters. First, freighters increase the capacity to supply cargo on routes where passenger flights are operated but cannot fill the demand of cargo deliveries. Second, with freighters it is possible to fly and carry cargo on routes that are not suitable for passenger flights. Third, freighters make it possible to carry large shipments that cannot fit into belly-hold of passenger aircraft. Freighter cargo volumes have been increasing for several years and are predicted to have moderate growth in foreseen future. Integrators have played a large role in increasing of freighters' cargo volumes. Busiest routes for freighters are transpacific, between Asia and Europe, and between Middle East and Asia. (Morrell 2011: 77.)

*All-cargo carriers* are airlines that only operate freighter fleet. Freighters are operated with regular schedule on routes with high demand of cargo. (Sales 2013: 3.) These airlines do not operate any passenger flights and their financial profits are based on delivering air cargo. Example of successful all-cargo airline is Cargolux. It is one of the largest all-cargo airlines in the world, partly because Luxembourg offers liberal air traffic rights. (Morrell 2011: 80.)

All-cargo airlines include also *integrators*. Their business strategy is to offer a complete air cargo chain including road haulage (pick-up and delivery), terminal work and customs operations for smaller air cargo. For the smallest packages (under 30kg) they provide all-inclusive prices and for larger shipments they exclude destination country's taxes and duties from the price. (Sales 2013: 3.)

Integrator or integrated carrier utilizes hub and feed model along with courier model (Morrell 2011: 99). Integrators were previously known as air express services. The name integrator comes from their ability to provide not just simple airport-to-airport and door-to-door services but comprehensive and special door-to-door transport solutions in B2B markets. (Wood etc. 2002: 184-185.) Their competitive advantage is built on reliable and fast delivery, guaranteed delivery times and transparency (tracking), as well as door-to-door services (Morrell 2011: 99). Integrators make their door-to-door transports more alluring by offering value-adding services and by providing user-friendly environment to occasional overseas shippers. Integrators have continuously increased the limitations for their shipments and took market share from the forwarders. (Wood etc. 2002: 185, 187.)

In practice, integrator's customer can make the transport order online and the nearest pick-up truck (usually subcontractor) collects the shipment as soon as possible and delivers it to nearest terminal. Shipments are consolidated in regional hub and flown to hub terminal. In the hub, shipments are sorted automatically and consolidated to flights and delivered to destination airport. From there a delivery truck transports the shipment to consignee. Customer can follow the progress of the transport chain online. (Morrell 2011: 99.) Integrators commonly operate their flights between hubs by night to optimize the distribution process (Wood etc. 2002: 186).

Integrated market is today dominated by four companies FedEx, DHL, UPS and TNT. It is challenging for newcomers to access the integrated market. Accessing to integrated market requires significant investments to IT and handling systems, vehicles, and aircrafts worldwide. Contrary to integrators, forwarders do not have aircrafts and handling systems in airports, and airlines lack the road distribution resources. Therefore, these companies

are not able to challenge integrators in integrated market. (Morrell 2011: 99.) Table 1 presents the ten biggest airlines based on freight tonne kilometres in both international and domestic flights in 2015.

Table 1. Ten biggest cargo carriers in 2015 (Statista Inc. 2016).

Carrier	Freight Tonne-kilometres (in millions)
<b>FedEx (integrator)</b>	15,799
<b>Emirates (combi)</b>	12,157
<b>United Parcel Service UPS (integrator)</b>	10,807
<b>Cathay Pacific Airways (combi)</b>	9,935
<b>Korean Air Lines (combi)</b>	7,761
<b>Qatar Airways (combi)</b>	7,660
<b>Lufthansa (combi)</b>	6,888
<b>Cargolux (all-cargo carrier)</b>	6,309
<b>Singapore Airlines (combi)</b>	6,083
<b>Air China (combi)</b>	5,718

*Courier and postal companies* are specialized in carrying of documents and small packages. They offer fast and secure small shipment services all over the world. Courier industry as a separate industry diminished when integrators absorbed their services. Postal services use their own surface transport and terminal network but purchase space from airlines' passenger flights for their shipments. In different countries, like in Finland and UK, government's post offices hold the license for offering letter services. These also offer parcel services as an integrated or separate company. (Morrell 2011: 98, 109.) The biggest threat to air-mail is use of e-mail and EDI. These will electronically deliver the documents anywhere where sufficient IT infrastructure is available. (Wood etc. 2002: 187.)

*Charter airline* operates a fleet of freighters to provide charter and ad-hoc services. Charter airlines handle special customer demands requiring cargo deliveries to destinations

where is not regular scheduled freighter service offered. They also operate scheduled services to almost any destinations as per the request from specific customers. (Sales 2013: 3.) Aircrafts are commonly chartered for a certain period or flight including personnel and fuel (Wood etc. 2002: 182). Example of airlines offering charter services are Atlas Air and previously mentioned Cargolux. Charter brokers are parties that are specialized in sourcing of charter services for their customers. Customers can charter the whole space from aircraft or part of it, depending on the situation. (Sales 2013: 3.) Load factors are often high in charter flights because customers will fill the whole plane to gain all the economic benefits from chartering. (Wood etc. 2002: 182.) Charter services are used in disaster relief operations, military operations and construction projects. It is usually more economic option to outsource freighter flights to charter airlines than lease aircraft and its personnel. (Morrell 2011: 82-83.)

*Freight forwarders* are non-asset based delivery service providers. They organize transports behalf of companies (Sales 2013: 8). Forwarders act as an indirect air carriers, retailers of aircraft space when airlines are the suppliers. Forwarders consolidate small shipments to large shipments and hence gain affordable air freight charges. This way they can charge higher fees from shippers and ensure their marginal profit. (Wood etc. 2002: 188.) Companies use forwarder services to make sure that shipments are delivered safely and fast to consignee (Sales 2013: 8). Freight forwarder may hold its own assets like trucks but usually they outsource activities to third-parties (Morrell 2011: 109).

In air freight industry, forwarder's tasks include finding the best route, bargaining the best freight rate for the cargo, arranging pick-up, and ensuring correct packaging and documentation for the shipment. Forwarder often also arranges the final delivery for the shipment from airport of arrival to consignee. (Sales 2013: 8, 13.) Forwarders offer variety of services like airport-to-airport, door-to-airport, airport-to-door and door-to-door. Customs clearance, insurance, and documentation drawing are additional services that they provide. Excluded from the standard chargeable weight price for a shipment, forwarders charge handling fees at airport, risk surcharges, fuel surcharges, charges regard-

ing customs clearance process, and security charges. (Sales 2013: 6.) Forwarders' advantage to integrators is their ability to handle shipments of any kind, and especially to offer better solutions for delivering large shipments (Wood etc. 2002: 188). Large global forwarders like DHL and DB Schenker dominate the international market. (Morrell 2011: 109.)

### 3.1.5 Air freight costs

In the past, IATA set rates for air freight industry. At one point, it was noted that this was not fair approach and IATA slackened its control. Today, IATA's influence is minimized but it still holds meetings with airlines to create discussion about current and future rates. (Wood etc. 2002: 189.) IATA has also solved disagreements between airlines relating reimbursements of cargo charges and set public cargo tariffs to line-haul airlines. However, customers rarely pay these prices because likewise in passenger market airlines offer discounts for freight. These linehaul airlines mostly sell their cargo space to customers through GSAs or forwarders. (Reynolds-Feighan 2001; Wood etc. 2002: 189).

Air freight rates are mostly determined by the relationship of supply and demand. It is even more significant factor than the transport distance. Seasonality and weather conditions may also decrease the supply of freight capacity if e.g. aircraft needs to carry more fuel to prepare for longer landing procedures due bad weather. Routings impact on rates since faster straight flights are more expensive than flights with stopovers. Variable cost factors like dimensions and weights of shipments as well as commodity types affect the rates by determining how much space the shipment needs and possibly rule out some routing options. If the freight requires special handling procedures or conditions, or has high priority, its rate is more expensive. Forwarder's purchasing power as well as freight volume and regularity impact directly to freight rate. (Logistiikan maailma 2016h; Reynolds-Feighan 2001.) Trucking charge also varies along with shipment type and size, delivery distance and ordered transit time (Sales 2013: 18).

- There are many categories of airline rates, for example:

- Traditional tariff rates for general commodities (minimum charge + weight factor between points A and B)
- Rates for shipments loaded in ULDs and containers (minimum charge + weight factor between points A and B)
- Contract rates (charge per kilo agreement e.g. between airline and forwarder) (Wood etc. 2002: 189-190.)

Air freight rates are given as price per kg except bulk cargo which is determined by cubic meters (Logistiikan maailma 2016h; Wood etc. 2002: 191). When the shipment's weight (kg) increases the price per kg decreases. Freight rate is determined either by gross weight or by volume weight. The global standard for volume weight in air freight is six cubic decimetres or six litres equalling to one kilogram. This means that one cubic meter equals to 167 kilograms ( $1 \text{ m}^3 = 167 \text{ kg}$ ). Volume weight can be calculated by dividing the cubic centimetres of a shipment with 6000 or by dividing its cubic decimetres with six. When the volume weight of the shipment exceeds its gross weight then the volume weight is used as chargeable weight. If the price of chargeable weight is lower than the minimum charge on the route, then the minimum charge will be used. (Logistiikan maailma 2016h; Karhunen etc. 2004: 300.) Table 2 shows an example of air freight tariff list.

Table 2. Example of air freight tariff list (Logistiikan maailma 2016h).

<b>Destination</b>	<b>Mini- mum charge</b>	<b>+45kg</b>	<b>+100kg</b>	<b>+200kg</b>	<b>+300kg</b>	<b>+500kg</b>	<b>+1000kg</b>
Boston	55,00 €	2,50 €	1,50 €	1,40 €	1,30 €	1,20 €	1,10 €
Los Angeles	75,00 €	3,50 €	2,50 €	2,40 €	2,30 €	2,20 €	2,10 €
Dubai	35,00 €	1,90 €	0,90 €	0,80 €	0,70 €	0,60 €	0,50 €
Hong Kong	60,00 €	3,00 €	2,00 €	1,90 €	1,80 €	1,70 €	1,60 €
Shanghai	58,00 €	2,80 €	1,80 €	1,70 €	1,60 €	1,50 €	1,40 €

The price of chargeable weight is not the actual rate charged from an air freight. There is variety of additional fees added to price. (Sales 2013: 18.) Terminal charge includes the cargo handling at airport and is charged as price per kg. Security charge is charged only

in export deliveries and it is constituted from security procedures that the shipment goes through. In case of dangerous goods, additional fee is charged for specific handling and inspection of dangerous goods shipment per its packaging and documents. Fuel surcharge index and risk surcharge are also charged from shippers. Risk surcharge was taken in to use after 9/11 when airlines faced dramatic demand of insurances and the subsequent rise of insurance costs. It also compensates the increasing risk of terrorism and crime directed to airlines. (Logistiikan maailma 2016h.)

Costs of freight airlines can be divided to capital and maintenance costs of aircrafts, and to administration and operation costs of aircrafts. Capital costs consist of depreciations or rental fees and interest expenditures. Maintenance costs are constituted from maintenance staffs' wages, facilities, as well as purchasing and handling of equipment and spare parts. Administration costs include wage, material, facility and appliance costs produced by management, financial administration, HR management and Research & Development. Operation costs include personnel wages, energy and material costs, and traffic charges. These costs can further be divided to fixed and variable costs. Fixed costs include for example capital costs of aircrafts, rental fees of facilities, and wages of management and administration. Variable costs are formed by costs created from activities. Wages of personnel, energy costs and traffic costs are the most significant variable costs. (Karhunen etc. 2004: 300.)

### 3.1.6 Future in the market

IATA (2015) predicts that air cargo income might slowly decrease. This is the consequence of the weak load factors that will reflect to financial performance of air cargo industry. More and more commonly air cargo users favour more environmental friendly and cheaper modes of transport. Forwarders have answered to these needs by creating more multimodal transport options combining the benefits of each mode. In addition, initiatives like the new land-based '*Silk Road*' between China and Europe takes customers from sea and air cargo service providers. (International Air Transport Association 2015.) That is why air cargo business will inevitably face some changes and it needs to adapt

better to future global market. Example of a change is the need to integrate with other transport modes and companies by boosting further the mergers and alliances. This must be done to offer even more efficient door-to-door services to consumers and Just-In-Time services to industries. (Tseng etc. 2005: 9.)

In the other hand, there are some issues empowering the development of air freight industry. These issues are such as globalization of business, increase in living standards and increase in value of products. Investments in unbroken cool chains will continue to grow in the foreseen future. Vegetables, fruits, flowers and pharmaceutical products will still be manufactured worldwide and increase the volume in air freight. Automotive industry will produce more eco-friendly cars, which will boost the volumes of spare parts and components. Furthermore, new innovations related to movement will also gain market share and require deliveries. (Sales 2013: 199.)

One of the most interesting issue in air transportation's future is finding the alternative to current aviation fuel. Fossil fuel resources are diminishing so it is probable that the new fuel is released roughly 20 years from now. This will have significant impact to aviation and world's economy. (Sales 2013: 199.) However, oil price volatility and geopolitical concerns are already creating variation to air cargo demand and impacting global economy (International Air Transportation Association 2015).

Payload capability of aircrafts is not predicted to increase significantly in near future but in 20 to 30 years from now it is expected to increase to 300-400 tons. Classic freighters, like B747-200F, are disappearing because the fuel price makes flying of those unaffordable. Long-range and fuel-efficient freighters are more in demand since short-haul cargo is being shipped mostly in belly-hold of passenger aircrafts and with road feeder services. (Sales 2013: 198-200.) Cargo aircrafts will not lose their ground in the foreseen future because they allow transports of cargo with variety of size and type. All-cargo aircrafts will also allow suitable and efficient departure and arrival times for the needs of air freight. Use of the belly cargo is limited by the size of belly-hold and the difference in

destinations between passenger and cargo traffic. (International Air Transportation Association 2015).

However, even if the payload capability of aircrafts is not increasing the capacity still increases through increase in the cargo aircraft fleets and growing passenger business. This creates challenges to air freight industry. Air freight load factors have already remained in the not admirable rate of 45 percent. (International Air Transport Association 2015.) Load factor measures the occupation percentage of an aircraft (Lowe 2002, 146). Even though utilization rates of aircrafts have increased the increasing capacity will harm this trend. IATA estimates that in 2027 there will be over six billion passenger journeys per year. This kind of development has already created a threatening phenomenon to cargo airlines that is called 'buy & carry'. Such companies as Entrusters, PiggyBee and Packmule are crowd shipping services practising 'buy & carry' business. These businesses connect people who want to ship something with airline passengers who are willing to deliver these shipments in their luggage. Tourists' self-shipping is also starting to affect air cargo due the dramatic increase of passenger flights. (International Air Transport Association 2015.)

When we consider the effects of technological development it can be noticed that lifecycle of commodities is going to remain same or even decrease because of it. This decreases the stock sizes while boosting quick deliveries. Manufacturing industry will further shift the final assembly of products near or into large consumer markets. (Sales 2013: 198-199). For example, advanced technological devices are valuable products whose storing is expensive. That is why it is in many cases more affordable to make the final assembly of these products near the selling point and quickly deliver those to customer. (Karhunen etc. 2004: 291-292.) Components will be still manufactured in low-cost countries meaning that there will be a need for long-haul air freight transports (Sales 2013: 198-199).

In the other hand, disruptive innovations affect negatively to air freight volumes. (International Air Transport Association 2015.) For example, 3D printing is going to reduce shipping of supplies. It is impossible to say how significant impacts it will have and when,

but certainly it will affect the freight quantities. In overall, technological development will have both negative and positive affects to air freight industry. (Sales 2013: 198-199.)

In the IATA's air cargo strategy for 2015-2020 it was predicted that air cargo volumes will grow 4.1% annually in next five years. In the same publication, it was expected that this growth will be spread mostly to Africa and Middle East while Europe and North-America would face growth well below the global average. Trade lanes between North and South America, as well as Middle East and Africa, and within Middle East was predicted to gain the strongest growth. In addition, domestic flights in US and China are predicted to produce a large share of the growth. (International Air Transport Association 2015.)

Reason for the expectations of growth in emerging markets especially in Asia is caused by urbanization which will create new metropolitan areas. These areas will boost the world's economy by increasing population and GDP. Air cargo industry and whole aviation will have an opportunity to exploit this growth. However, the industry must be developed by creating more value and competitiveness to services to ensure that other transport modes will not steal its portion of the growth. (International Air Transport Association 2015.)

Recent publications show that a moderate growth is still prevailing in air cargo industry but global trade have not yet strengthened. Measured in global air freight tonne kilometres (FTKs) the annual growth was 4.0% year over year (YoY) in July 2016 and 3.9% YoY in August 2016. Freight capacity saw a growth of 4.1% YoY in August 2016 while the load factor stabilized to 42-43% affecting negatively to freight income. What has been a surprise is that the fastest annual growth was produced by European airlines while growth in Middle East traffic has decreased. In both Dubai and Abu Dhabi airports the cargo throughput decreased, which was caused by Middle Eastern airlines losing ground to European airlines on the route between Europe and Asia. Routes in, to and from Asia have seen the strongest growth, and overall the cargo volumes are increasing. Collapse of Korean container shipping company Hanjin boosted the demand during the peak seasons.

The moderate increase in export orders also affected positively to cargo volumes. (International Air Transportation Association 2016.) Table 3 below shows the historical and forecasted air cargo growth rates in major markets (Crabtree etc. 2016).

Table 3. Historical and forecast air cargo growth rates (Crabtree etc. 2016).

<b>Region</b>	<b>History 2005-2015 (%)</b>	<b>Forecast 2015-2035 (%)</b>
World	2.0	4.2
Asia-North America	1.9	4.6
Europe-Asia	2.1	4.6
Intra-Asia	2.1	5.5
Europe-North America	0.4	2.4
Intra-North America	-1.4	2.2
Domestic China	7.6	6.2
Latin America-Europe	3.3	3.8
Latin America-North America	0.7	4.3
Africa-Europe	0.4	3.8
South Asia-Europe	3.5	5.0
Middle East-Europe	3.6	3.9
Intra-Europe	1.6	2.2

### 3.2 Export air freight process

Domestic and internal deliveries are often handled as ground transports rather than air transports. Air transport is used in cross-border deliveries where goods are exported from one country and imported to another country. A shipper is the party who wants to move the goods. Shipper can be a vendor, buyer or some third-party. Shipper does not necessarily have resources to execute cross-border air deliveries by itself. That is why it is

common that the shipper will buy the whole air freight service or part of it from specific service provider. (Morrell 2011: 155.)

A typical air freight chain consists of several operators and several steps. Export air freight process starts when the exporter and the importer make a commercial deal, which requires transporting of goods by air. Consignor packs the goods properly to withstand handling activities along the transport chain. The consignor provides packing list (specifies the distribution of goods in individual packages) and invoice (proof of value) along with the shipment. (Morrell 2011: 155; International Air Transport Association 2014; International Air Transport Association 2008.) Invoice is essential since it is used to determine the Customs value in the imported country. Exporter states the selling price, and costs for insurance, freight and packing etc., as well as the payment term and delivery term in the invoice. (International Air Transport Association 2008.)

When the shipment is ready for transport (RFT), shipper makes a transport booking to freight forwarder, airline's agent or directly to airline. If the booking will not go directly to an airline, the cargo space from airline is booked by forwarder or airline's agent. Shipper's booking must include a letter of information providing information about service required, origin and destination, collection and delivery dates, number of pieces and parcels, gross weight, dimensions, other shipment details, as well as shipper and consignee information along with the invoicing address. Shipment's trade information must also be provided with the booking. This includes information about customs/security requirements, transport and trade itself. Party who received the booking checks the security status of the shipper. If the booking is received by an airline directly, then airline must also check the security status of the forwarder/carrier(s) it uses in road transportation. The security status must be validated so that the security check procedures can be adjusted properly. (Morrell 2011: 155; International Air Transport Association 2014.) For example, if the shipper is Known Consignor or the forwarding agent is a Regulated Agent there is loosen requirements in some of the security procedures and more streamlined security process. Known consignor is a company who manufactures or assembles the product from parts in which prohibited objects are clearly noticeable and easily removable, and who

has been given a known consignor certificate. Regulated agent is a forwarder or transportation company who executes security procedures for air freight that are accepted or required by aviation authorities. Regulated agent has permission to consolidate shipments from known consignors in export process. (Trafi 2016a & Trafi 2016b).

Documentation for the shipment is compiled by the responsible agent(s), airline and customs. Common documents include:

- Master Air Waybill (the contract between shipper and airline)
- House Waybill (the contract between shipper and the agent for a specific shipment)
- Cargo Manifest (detailed list of goods)
- House Manifest (contain similar information as the Cargo Manifest but as per the House Waybill and forwarder's consolidation)
- Export, Import and Security Declarations
- Certificate of Origin and Dangerous Goods Declaration if required. (Sales 2013: 8; International Air Transport Association 2008; Logistiikan maailma 2016c.).

Air Waybill (AWB) is air freight shipping document used in both international and domestic flights. It describes carrier conditions (claims procedures, limits of liability etc.) and is the contract for carrying goods. Further, it provides shipping instructions for airlines, describes the commodity, and indicates shipping charges. (Custom Global Logistics, LLC 2016.) It is a confirmation receipt and air ticket for the shipment. House Air Waybill (HAWB) is used when an individual shipment is handled by a forwarder. Master Air Waybill (MAWB) is used, if forwarder consolidates many different shipments from different shippers to a one large shipment. Every smaller shipment in this large consolidated shipment has their own HAWB and hence the forwarder is the shipper by providing the MAWB. (Morrell 2011: 155.) IATA is converting many of the documents to electronic format to reduce the amount of paper in the process and to make the process more efficient. (Sales 2013: 8.)

Forwarder picks up the shipment and verifies that the shipment matches the documents provided by the shipper, as well as visually checks that the shipment is packed correctly and that it contains necessary documents. If the package is suitable, transportation company labels the packages unless it has agreed that the shipper handles labelling. The labelling can also be done later if the shipment will be delivered through forwarder's terminal. Labels contain shipper's reference, part numbers and identifiers. This will make the packages identifiable during the transportation chain. When the shipment is loaded to the truck, forwarder gives a proof of acceptance to the shipper (POA). (International Air Transport Association 2014; Sales 2013: 5-6.)

Shipment is delivered to the forwarder's terminal or directly to the airport of departure. If the shipment is delivered to terminal, it is first checked-in by scanning the shipment ID. Then if the shipper has labelled the shipment, suitability of those labels is checked. If those are not suitable, then respective labels are attached by the forwarder. Packages are also checked visually to make sure those are applicable. In addition, the actual weight and dimensions are measured. The existing shipment info is confirmed to the actual shipment arrived. When the information regarding the actual shipment is validated it is matched to the booking information. If these does not match, then the booking info is modified and extra payment charged from the shipper for any major changes. If all above mentioned issues are acceptable, the service level, capacity requirements and handling requirements are set. Then the shipment is made ready to be collected and consolidated with other shipments to outbound vehicle departing to the airport of departure. (International Air Transport Association 2014.)

Truck arrives to the cargo terminal of the airport in booked time slot or before the latest acceptance that is determined by the airline (cut-off time). Airline's or airport's GHA (ground handling agent) works in the reception of cargo. It is responsible for the handling chain in the airport, from arranging unloading times for incoming trucks to loading ULDs to a plane. It is not uncommon that this handling chain includes more than one operator. (Sales 2013: 8-9.)

First the security status of the truck and driver is checked. Cargo is also checked prior the unloading in the air cargo terminal by airline's ground handling agent. The existing info is matched against the actual cargo and its documents, and the packages are checked visually during the unloading. Next, the security status of each shipment is checked. This will include checking that the export clearance requirements comply with the security status of the shipment. Shipper and forwarder status are validated (if not done yet) along with screening and X-ray requirements. (International Air Transport Association 2014.)

Even if the shipment is from a 'known shipper' the shipment must still be checked to some destinations, e.g. to USA. Otherwise this kind of shipment is deemed safe to fly and has more streamlined security process given that the shipment contains a cargo security certificate. If the shipment is not from a "known shipper" it is defined as an 'unknown' cargo. This means that it must go through stricter security procedures like X-ray screening and a physical inspection. This can be done by a Regulated freight forwarder or another similar agent. However, if there are not such parties available then the safety procedures are airline's responsibility. This usually means that the cargo is checked by X-ray or by hand-search in the airport. This will lead to earlier cut-off time in the airport so that the proper procedures can be made. (Sales 2013: 7-8.)

When the GHA has carried out the required safety procedures and prepared necessary documents for exit customs procedures, the shipment's security is validated and cleared for carriage. Shipment is moved to warehouse location from where it is loaded to correct flight along with other shipments delivered to same destination. Shipments are transferred from wooden pallets or other units and consolidated into ULD containers or onto ULD pallets. (International Air Transport Association 2014; Sales 2013: 8-9.)

After the shipments are consolidated for the flight, GHA delivers the ULDs to the Hold Area from where the ULDs are made ready for ramp transport. GHA provides ramp personnel with a paper manifest showing all the information about the cargo. Cargo is moved from Hold Area to aircraft's Parking Position and the manifest forwarded to the aircraft's personnel on board. According to load control requirements and load plan, the ground

handling unit loads the aircraft until load sheet is completed. In any discrepancies, the aircraft personnel and cargo department is immediately notified. The manifest is adjusted as per possible discrepancies and offloads re-planned. The result of an aircraft loading must always be an accurate manifest with all the discrepancies resolved. After the loading of passengers and cargo, the aircraft receives a permission for take-off. (International Air Transport Association 2014.)

Airline will inform the GHA at the airport of arrival with all the documents, including shipment information, manifest information and flight information. This will make it possible for the GHA to create an unloading plan for the aircraft prior its arrival. When the aircraft has been unloaded according to the unloading plan and cargo checked for any discrepancies, shipments are delivered to correct facilities for processing. Shipments are handed to the GHA's control into warehouse. GHA will check the cargo information and break down the ULDs if necessary. The cargo is checked for any damages and identified. (International Air Transport Association 2014.)

Shipments in transit are moved into export process for further carriage with the approval by other carriers. Import cargo is allocated to different storage locations as per their requirements. Importer and forwarder are notified about the arrival of the shipment and shipment information is sent to them. Before shipments are released for collection their customs status is checked and verified. This is done according to local customs requirements, which are compared with the shipment's customs status. Shipment is categorized along with the customs decision to release it or not. (International Air Transport Association 2014.)

When the shipment is released it will be picked up from the warehouse by a forwarder. This can be either the same forwarder already operated in the chain or another forwarder appointed by the importer. Prior the collection driver must be authorized and the collection vehicle approved. Driver receives all the documents related to shipment e.g. inbound customs document, and notifies the consignee about the delivery time. The shipment is once again checked in the forwarder's terminal and/or in the delivery place. If damages

or mistakes has occurred during the transportation chain, proper cargo claims will be sent to relevant parties. Forwarder's responsibility ends when the shipment is handed over to the consignee or its representative and forwarder receives proof of delivery (POD). (International Air Transport Association 2014.)

## 4 DEVELOPMENT OF THE AIR FREIGHT SERVICES

Improving the current export air freight process for the air freight services of FREJA Transport & Logistics Oy is the empirical subject of this master's thesis. As mentioned earlier, this study was conducted through a case study and action research methods. Air freight process involves many different operators as well as employees so it is essential to gather information from these sources and hence the choose of qualitative research as the main approach.

This chapter examines the background of the air freight process improvement. At first this chapter provides information about the client organization FREJA Transport & Logistics Oy. FREJA's history, services and organizational structures are presented to make the reader familiar with the organization. Next, the reasons for subject selection are presented by answering to questions how the subject was developed and why it was chosen to this master's thesis. After this chapter introduces the starting point, information gathering methods, factors to consider, and desired outcome of the empirical part.

### 4.1 FREJA Transport & Logistics Oy

FREJA Transport & Logistics Oy is part of Danish logistics and transport group FREJA Transport & Logistics Holding A/S. FREJA group provides worldwide freight forwarding and logistics solutions. It was established in Skive, Denmark in 1985 by the current group president Jørgen J. Hansen. In 1990, corporation made it first expansion when it acquired a subsidiary from Copenhagen. Later it made more acquisitions and started shifting towards more comprehensive logistics solution provider. In 1997, organization changed its name from FREJA A/S to FREJA Transport & Logistics A/S. Between 1985 and 2016 FREJA has had 20 percent annual growth rate. (FREJA Transport & Logistics A/S 2016a.)

Group's headquarter is in Skive, Denmark and it currently has 16 other offices, which are located in Denmark, Finland, Sweden, Norway and China. Group's turnover was 325 million euros in 2015. It has 600 employees and approximately 1.5 million consignments per year. Group has 1600 trailers and 250 direct groupage lanes, it is one of the largest privately owned transportation groups in Nordic countries. FREJA group holds Quality: ISO 9001:2008 and Environment: ISO 14001:2004 certificates, has AEO certification and is IATA agent. Group's service portfolio includes road transports, sea and air freight, project forwarding, warehouse solutions, healthcare logistics and customs clearance. However, service portfolio varies in different countries. (FREJA Transport & Logistics A/S 2016a; FREJA Transport & Logistics A/S 2016b.)

FREJA Transport & Logistics Oy is Finnish company part of FREJA group. It previously operated under the name Maa ja Meri Oy. In 2003, FREJA made its first Nordic takeover when it bought the majority of shares in Maa ja Meri Oy. Maa ja Meri Oy was originally established in 1942 and started its operations by serving Finnish military during the World War II by transporting and shipping war equipment. Maa ja Meri Oy used its original name until 2009 when FREJA group decided to harmonize the names of the companies' part of it. Since then company has been known as FREJA Transport & Logistics Oy. (FREJA Transport & Logistics A/S 2016a; FREJA Transport & Logistics A/S 2016b.)

FREJA Transport & Logistics Oy provides transportation and freight forwarding services worldwide. Company's core competence is in international FTL, LTL and groupage cargo road transportations in Europe, CIS countries and Scandinavia. Transports include exports from Finland, imports to Finland, and cross-trades in Europe. Other services include worldwide air freight, sea freight and project transports as well as express and temperature controlled transports. Services are executed with own resources and equipment as well as with extensive subcontractor and partner network. (FREJA Transport & Logistics A/S 2016a; FREJA Transport & Logistics A/S 2016b.)

FREJA Transport & Logistics Oy employs 45 professionals in Finland with three offices. Headquarter is in Turku, from which export, import and cross-trade road transportations

are handled around Europe and CIS countries. Road transports in Scandinavia and world-wide air freight services are operated from Vantaa office. Project transports and sea freight are operated from the office in Vaasa. Company's turnover in 2015 was 63 million euros. It handles some 100,000 consignments per year. Company has over 500 trailers and 25 direct groupage lanes. (FREJA Transport & Logistics A/S 2016a; FREJA Transport & Logistics A/S 2016b.)

## 4.2 Background

This project started when the researcher inquired from the managers of FREJA's road traffic department if they would have some issues that could be used in master's thesis. When they did not have any subjects to work with, researcher contacted the managing director of FREJA Transport & Logistics Oy and let him know about the ideas he had developed. One of the ideas related to FREJA's new air traffic department and the managing director agreed that it would be the subject to work with. The subject for this master's thesis was brainstormed together with FREJA's air traffic department when they visited FREJA's headquarter in Turku.

FREJA's air freight department was established in 2016 when FREJA announced that it would strengthen its services with air freight transports starting from September 2016. This was done to utilize FREJA's knowledge and contacts in the field of air freight, to support project transports and to provide customers with more diverse service portfolio. FREJA's air freight services provide export, import and cross-trade air transports for shipments starting from 100 g to over 10 000 kg. Common shipments are machines and machine parts with delivery speed as the main driver. Target destinations include USA, Asia and South America. (FREJA Transport & Logistics Oy 2016.)

Because FREJA expanded its services just recently it is obvious that the current business processes in the new department are not running with their full capacity. Export air freight process is one example of such process. There was room for improvement to utilize more

FREJA's own resources and to make the process more efficient. This was done to reduce costs, gain competitive advantage and provide added-value.

The starting point for this thesis was to improve a business process for recently established department in a logistics and transportation organization. Since the department is brand new, personnel were constantly busy making it challenging to gather information regarding the air freight services. It was crucial for this thesis to receive information from the people working daily with air freight. Research data was acquired through interviews and enquiries, and by observing. Interviews and enquiries were made to personnel of FREJA Transport & Logistics Oy and its partner organizations.

Researcher had already familiarized himself to client organization's road transport operations and processes by working there in spring and summer 2015 and in summer 2016. He also worked occasionally during autumn 2016 and began working full-time in December 2016. Lot of the observations were made alongside researcher's work duties. By understanding the company's business model, it was possible to more profoundly find solutions to the air freight process.

Empirical part of the study was conducted by using an example shipment in different example cases. The example shipment was handled through both current and improved export air freight process. This example shipment consisted of 2 non-stackable EUR-pallets containing engine parts, with 120 cm height per pallet and total gross weight of 1100 kg. Consignor of the shipment was in Vaasa, Finland and the consignee in Long Beach, USA. However, the vendor and buyer had agreed that the vendor purchases the transportation from Vaasa to LAX airport in Los Angeles. The buyer arranged further transport from LAX to consignee's facility in Long Beach. However, this part was not included in the study. Examined export air freight process ended when the shipment was placed available for collection at destination airport.

In example cases FREJA bought air freight services from different GSAs. For example, in Vaasa-Copenhagen-LAX example case, service was bought from one of the industry

leaders Kales Finland. Kales Finland is part of multinational independent corporation Kales Airline Services, a global general sales and services agent (GSSA) established in 1994. They sell passenger and cargo products behalf of different airlines worldwide, such as American Airlines, Cathay Pacific Cargo and British Airways World Cargo. (Kales 2016a & Kales 2016b.) The aim of using an example shipment and cases was to create comparable results. This made it possible to more reliably show which one of the processes was more efficient.

In the current export air freight process, FREJA acted as a supplier, an organizer, and as a link to authorities while keeping up the transparency throughout the transportation chain. Airline or its representatives were responsible for most of the practicalities (road haulage, security check, air transport etc.). (Logistiikan maailma 2016a.) Actual service in the chain was produced by third-parties, meaning that they also determined the prices. FREJA offered air freight services to customers based entirely on prices negotiated with airlines or its representatives. This meant that FREJA's influence to prices was minimal.

Only by increasing control in the air freight chain FREJA would gain leverage to affect the freight prices. FREJA's practical work included purchasing pick-up service, purchasing cargo space from airline, handling and creating of documents (e.g. AWB and export declarations) monitoring and keeping customers informed about the course of transport, solving possible problems and incidents happened during the transport, and carrying responsibility of cargo.

If FREJA would increase its role in the air freight chain, it would respectively carry more responsibility of cargo. However, because carriers and forwarders are responsible for cargo they carry, freight insurance is used to insure their responsibility regarding the cargo handled. Carrier's responsibility is regulated in different transport modes by national and international laws and conventions. Goods in transit insurance between vendor and buyer regulates whom is responsible of cargo during transit since carriers' responsibility is limited. Goods in transit insurance is usually defined as per incoterms agreed in the trade agreement. (Logistiikan maailma 2016b.)

FREJA's main assets are their fleet of semi-trailers and extensive partner network as well as competent information infrastructure. These issues created the premises for improving the export air freight process and increasing FREJA's role in air freight chain. Every week FREJA Finland operates roughly 300 export trailers around Europe. About 250 of these are operated in Scandinavia and Western Europe where the major gateway airports are located. Even though load factors are high for these trailers there would be still enough space to consolidate air cargo to this network. Groupage trucks leave from Finland to Europe on Tuesdays and Thursdays enabling suitable transit times to gateways. Transit time for groupage and part loads from Finland to Denmark is three to five days, and to Netherland and Germany four to five days. Full truck loads (FTL) are arranged on the customer request making transit times very flexible.

Crucial success factor for handling air cargo is to have cargo terminal that meets the requirements of air cargo. FREJA's domestic haulage partner Kaukokiito has their own cargo terminal near Helsinki-Vantaa airport that possess qualification to handle air cargo. Required IT infrastructure between FREJA and the haulage firm is already established since they exploit EDI (Electronic Data Interchange) connection between their ERPs to enhance their common operations. EDI refers to electronical transfer of data between organizations (Haapanen, Vepsäläinen & Lindemann 2005: 152).

ERP systems are used in comprehensive resource planning. In a transportation company, ERP system can be used to plan and execute coordination of trucks and shipments, planning of distribution networks, as well as in sales supporting and administrative activities. ERP systems were created to connect organizational functions and processes in one common platform. Further making it possible to provide real time database and planning tool for every department in organization. (Ritvanen etc. 2011: 56.) When the air freight chain is carried out by third-parties, use of FREJA's ERP system is limited to invoice purposes and to creating of transport bookings and necessary documents. It is possible to share data more extensively through the FREJA's ERP system and use its transport management application in organizing of air freight.

Goal of this business process improvement was to create efficient and practical export air freight process where FREJA's main assets are in more extensive use. Main driver for the business process improvement was the ability to offer competitive air freight services and gain foothold in the market. Market penetration will be achieved when the current process can be improved in a way that the improved process will be reliable and more cost-effective than the current one and creates added-value to customers.

## 5 IMPROVING THE EXPORT AIR FREIGHT PROCESS

The export air freight process was improved through DMAIC cycle. Each of the five phases were executed by using relevant tools and techniques. With DMAIC cycle the aim was to reduce variability which yields to air freight process and further to air freight services. Variation is a cause of different events like deliver quality, equipment inconsistency and demand fluctuation. These impacts to lead times, on-time deliveries, prices, data accuracy etc. and reduce consistency in services.

### 5.1 Define

Scope of the improvement project was to research export air freight process for shipments between 100 kg/0.4 ldm and 24 000 kg/13,6 ldm, which are transported by land to Europe and flew from there to destinations outside Europe. Import air freight process was not researched since that would have required a lot of additional resources and time. This would have made it impossible to focus thoroughly to both processes. However, this research provided basis for improvement of import process.

Problem in the current export air freight process was that FREJA did not use its resources efficiently and hence did not provide much of added value. FREJA holds large fleet of trailers and wide network of trucks. For example, their trailers were not used at all in the current process. In addition, their competent ERP system could have been integrated more deeply in the air freight process. By applying these resources, costs, errors and intermediaries could be reduced significantly. Preferred outcome of the DMAIC cycle was to create and adapt a solution which will enable these reductions and shift non-added value tasks under control of FREJA.

First thing in the development of the new air freight process was to find out how air freight is currently operated in FREJA. This required understanding of the company's operations.

Qualitative and quantified data was gathered from road and air departments and from external parties to form comprehensive picture about the process.

### 5.1.1 Critical to Quality

Customers' need, and requirements for fulfilling the need must be defined. Based on customer requirements, CTQ tree determines measurable factors that are truly critical to quality and customer satisfaction (Desai 2010: 43). Critical to quality factors are result from examining the Voice of Customer (VOC) and assessing drivers for it (Tolga, Bulent & Atwat 2012). VOC describes the needs and expectations of customers. Quite the contrary to CTQs, VOC is not easily measurable if measurable at all. CTQ tree for FREJA's air freight services is displayed below in figure 6.

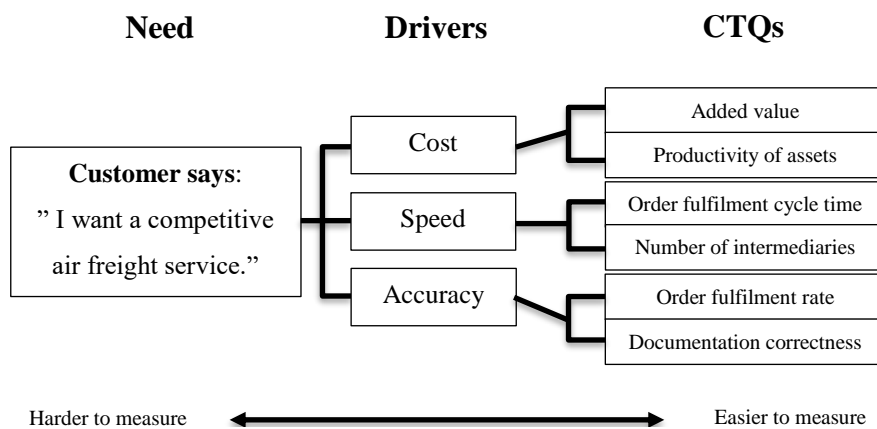


Figure 6. CTQ tree for air freight services.

For FREJA's customers it is important to have a competitive service. This means that the service is professionally executed as per the requirements of customers and with high quality. Drivers and requirements for competitive air freight service are cost, speed, and accuracy. Cost is the main issue why firms prefer to use other mode of transports rather than air. That is why cost-effectiveness of service must be secured. In the other hand, speed is the main reason why firms prefer to use air transport. Speed of air freight process is directly related to customer's willingness to pay for air freight service. Same goes with

the accuracy of the service. Nobody will pay for inaccurate service where their requirements are not met. Air freight must be delivered at the right time with the right quality and with the agreed price.

Measurable critical to quality factors for cost driver are added value that company can produce during the process as well as profitability of its assets. Added value in the air freight process is produced when FREJA utilizes its own assets and core competence instead of outsourcing those activities elsewhere. Created added value can be tracked by measuring how many percent of the process FREJA can execute profitably by its own. Highly related measure is profitability of assets indicating how successfully company can use its assets to earn profit.

Measurable critical to quality factors for speed driver are order fulfilment cycle time and number of intermediaries. With order fulfilment cycle time, it is possible to measure how quickly order can be fulfilled through the process. Large number of intermediaries slows down the process because data and goods are being shifted between operators. Process will become smoother if number of intermediaries can be reduced. There are often obstacles between different operators which prevent smooth interchange of data and goods.

Measurable critical to quality factors for accuracy driver are order fulfilment rate and documentation correctness. High order fulfilment rate is core of any transport process. Documentation correctness is a key factor enabling high order fulfilment rate. This is because with correct documentation it is possible to avoid errors in the chain when every party receives the same info that shipper provided in the beginning of the chain. Usually level of information accuracy increases when number of intermediaries decrease in the chain.

### 5.1.2 SIPOC

SIPOC (supplier, input, process, output, and customer) diagram is used in existing processes to describe relevant elements in a process and to provide high-level view of the

process. SIPOC diagram determines suppliers of input, identifies inputs required to process, shows major steps of the process, identifies outputs, and identifies customers who receive the outputs of the process. (Shankar 2009: 3-4). SIPOC diagram for FREJA's air freight process is shown in Figure 7.

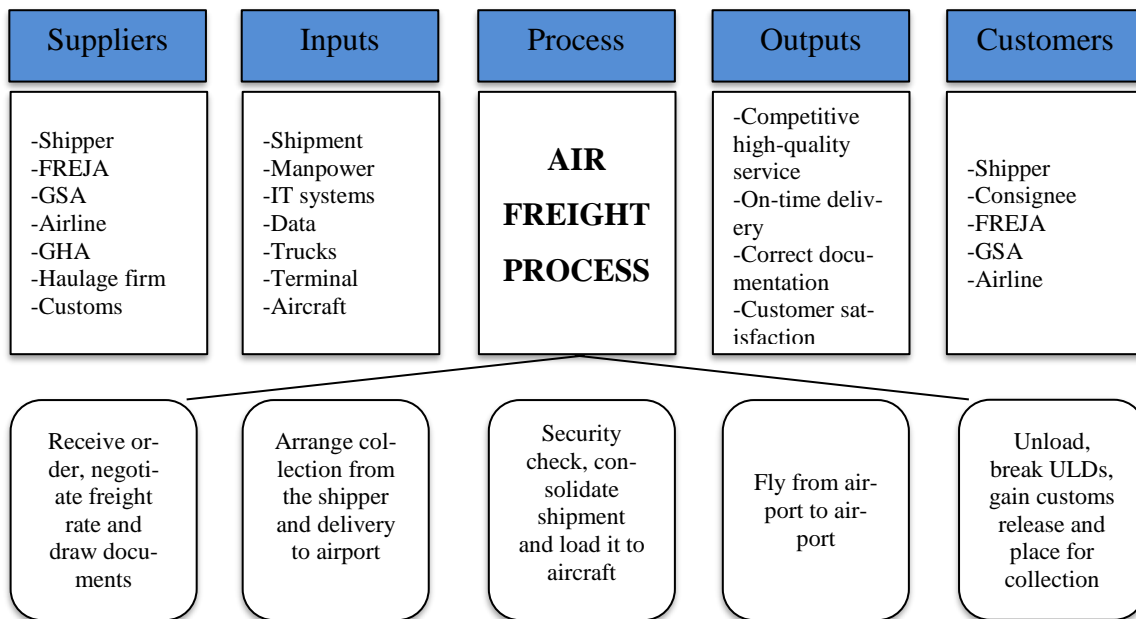


Figure 7. SIPOC diagram.

Suppliers of the air freight process are shipper, FREJA, GSA, airline, GHA, haulage firm and customs. They supply the inputs needed for the air freight process. These are shipment, manpower, IT system, data, road transportation equipment, cargo terminal and aircraft. Shipper launches the process by providing the shipment to be carried and the data to be interchanged. FREJA provides the infrastructure to the shipper in which its shipment is carried. This includes manpower, IT system and network of transportation companies. GSA supplies services of airline. Airline offers the aircraft with the cargo space where shipment is carried. GHA provides the terminal where the shipment is made ready for air transport as well as loaded and unloaded. Haulage firm offers the fleet of trucks that are used to carry the shipment by road. Customs produce necessary security and clearance services so that the shipment can be transported across different countries.

Outputs from the export air freight process are competitive high-quality service, on-time delivery, correct documentation and customer satisfaction. Customers are shipper, consignee, FREJA, GSA and airline. To produce on-time delivery output, GHA must provide necessary handling services to airline. Airline provides air transport to GSA, while GSA is responsible at producing on-time delivery to FREJA. FREJA is responsible at providing on-time delivery to shipper and consignee. Correct documentation is necessary for ensuring high-quality and legit delivery chain. Correct documentation output is produced by shipper providing all the necessary information correctly to FREJA. After this, FREJA is responsible to forward this information in correct form to other operators in the chain. Both on-time delivery and legitimacy through correct documentation construct competitive high-quality service in which the needs of customers are met. This will result as customer satisfaction.

### 5.1.3 Process chart (current export air freight process)

Process mapping helps to analyse processes by visualizing them. Process mapping is effective tool for process improvement and it is used in both service and manufacturing industries. Process map defines people, objectives, activities and data as well as their relationships. Process map can be used to reveal bottlenecks, unproductive use of resources, unnecessary steps, problems' root causes and non-value added tasks. (Siha & Saad 2008.)

Activities and interactions of different functions are showed in a cross-functional process map (CFPM) (Siha & Saad 2008). CFPM illustrates how inputs become outputs (workflow). A process is constituted from interrelated activities and it crosses several functions. CFPM can also be called a *swimlane diagram*. Patterns in the diagram are like lanes in an Olympic swimming pool. Benefits for using this kind of map are for example highlighted customer touch points, visible boundaries, workflow, and supplier-customer relationship. (Damelio 2011: 73, 75.)

Current export air freight process chart (figure 8) was constructed on route *Vaasa-Copenhagen Airport, CPH (gateway)-Los Angeles International Airport, LAX*. Process was constructed with FREJA and Kales Finland. It should be noticed that sometimes domestic pick-up is outsourced to GSA along with the haulage to gateway airport. However, domestic pick-up is already often handled by FREJA and hence the current process chart was constructed accordingly. Domestic pick-up is ordered from Kaukokiito to its terminal or to GHA (Swissport, ASR) terminals in Vantaa. From these terminals shipment is reloaded to GSA's international truck.

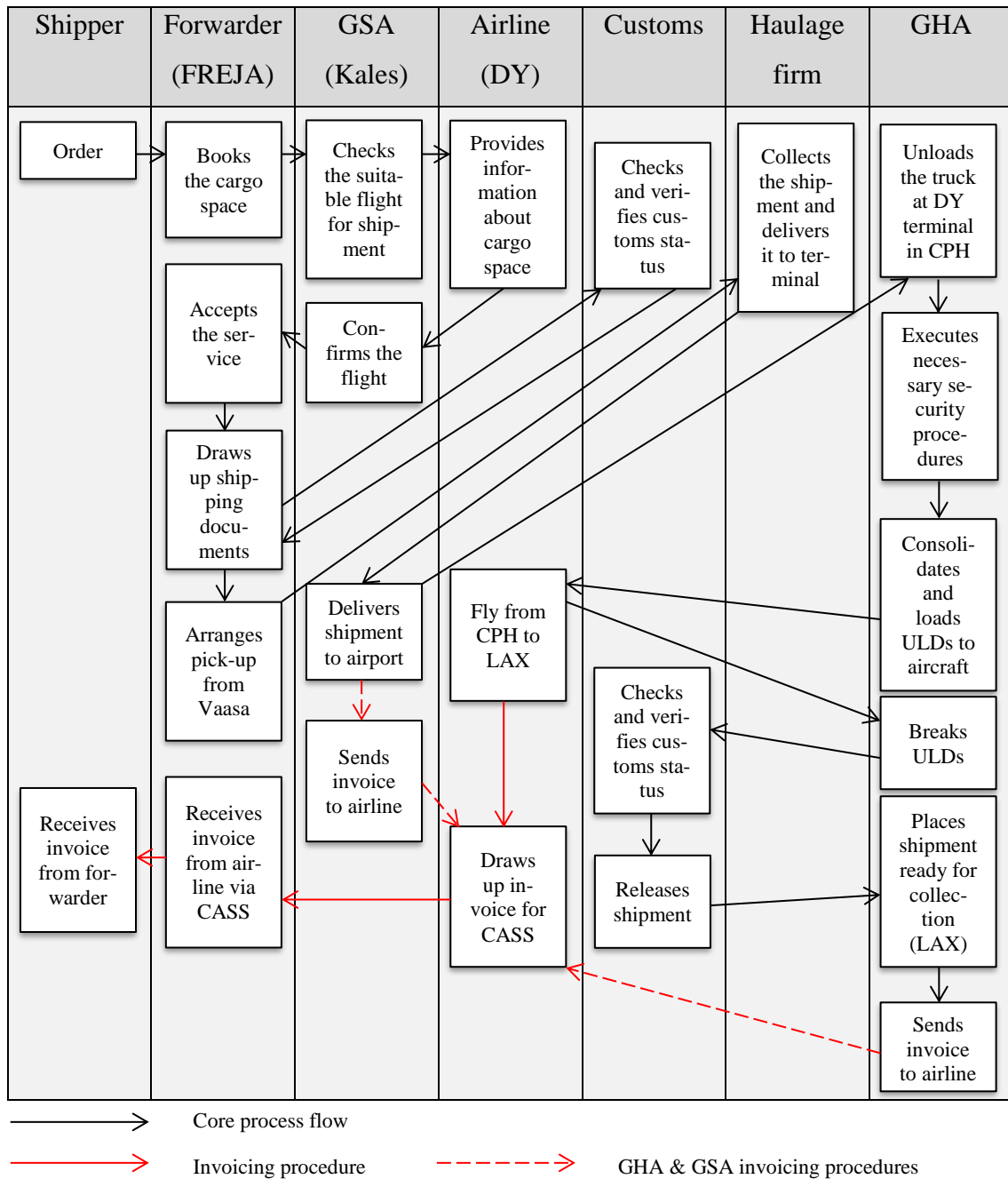


Figure 8. Air freight process chart (Vaasa-CPH-LAX).

Shipper (vendor) sends transport order via email to FREJA Transport & Logistics Oy requesting transport of air freight from Vaasa to LAX airport in Los Angeles. Shipper’s booking includes letter of information where ordered service, collection and delivery place, pick-up date, number of parcels, transport unit (2 non-stackable EUR-pallets), gross weight (1100 kg), dimensions (120x80x120cm/pallet), delivery term and invoicing

address are stated. More precise trade information is also provided regarding customs and security procedures and other business related issues.

When official transport order is received FREJA checks the security status of the shipper and starts arranging the transport. Officially received order means that the customer is trusting its shipment to FREJA who will be responsible for executing a successful transportation to it. In FREJA, a transport order is usually received by email, phone (followed by email), or with EDI. Most of the orders are done by email in every department but growing part of the orders are done with EDI connection especially in road traffic department. However, EDI is only used with long partnership contract customers because the connection will achieve its benefits only on long-term. FREJA in Denmark uses online ordering system where customers can independently make transport orders through FREJA's website and fill the required information fields by themselves. This decreases the level of incorrect information and switches some of the responsibility to customer in transport chain. However, FREJA Finland has not yet acquired this system. (FREJA interview 2016.)

As the shipper (customer) previously sent a transport order to FREJA, now FREJA becomes a shipper and will send a transport order to Kales Finland. Kales quotes most suitable flight to FREJA. Best solution in this case was Norwegian's passenger flight from CPH to LAX. FREJA accepts this option and agrees the price for it.

Shipper's order will be entered to FREJA's Aspect4 ERP system. This means entering manually all the information received in the order (including price) to create a ERP booking. It is essential that customer provides perfect information in the transport order so that there will be no need to contact the customer later and fulfill missing information. This will only increase the workload of FREJA and slow down the air freight process. Creation of ERP booking produces a booking number for the order which is further used as the reference for the shipment and as the reference for the invoice. With the booking in the system, air waybill and other necessary documents can be created. AWB can be printed or electronically sent from the system. Information in the system can be further used for

creation of export declaration, customs clearance and case labels. It is FREJA's responsibility to ensure that all the necessary documentation for the shipment has been created. Shipper is responsible for proper packaging of cargo. Shipper packs the goods properly to withstand handling activities along the transport chain. Along with the shipment, shipper provides packing list specifying the distribution of goods in individual packages and invoice proving the value of goods.

FREJA forwards all the information, documents and necessary references to Kales. Kales books the cargo space from the airline and provides airline with the information along with the documents sent by FREJA. FREJA works with customs and gets customs release for the shipment.

FREJA uses its haulage contractor Kaukokiito to collect the shipment from Vaasa. Collection is sometimes outsourced to GSA but only if there is no other way because GSA's collection costs are extremely high. Kaukokiito verifies that shipment matches the info that was given beforehand. It also visually checks that the shipment is correctly packed and that the necessary documents are attached. Contractor then loads the shipment into truck and hands proof of acceptance. Contractor delivers the pallets to its own terminal or some GHA terminal (Swissport, ASR etc.). In terminal, packages are labeled and consolidated (and sometimes security checked) to international truck heading to Denmark. This is the phase when the responsibility of the shipment becomes concern of Kales.

Truck arrives to Copenhagen airport's (CPH) cargo terminal (Kystvejen 28-32, 2770 Kastrup) at the booked time slot or before the cut-off time. Security status of the truck and driver is validated by GHA (WFS). Before the shipment is unloaded GHA checks that the documents match the shipment and that packages are adequate. After unloading, shipment is checked-in by scanning the shipment ID while the actual weight and dimensions are validated. Security status of the shipment is then checked to verify that the export clearance requirements comply with security status as well as screening requirements. This is followed by execution of the security procedures. When the shipment is

cleared for carriage it is moved to storage location from where it is consolidated to ULD and loaded to aircraft.

During the flight, Norwegian will send all the documents including shipment information, manifest information and flight information to LAX's GHA. After unloading at destination airport, shipment is delivered to cargo terminal where GHA will verify cargo information, break ULDs, identify the shipment and notify FREJA as well as the importer. If pre-customs clearance has not been done, then local customs check and verify the customs status and release it for collection. This is the phase where FREJA's service ends. Importer or its representative will pick-up the shipment from Norwegian's GHA Menzies Aviation (5625 West Imperial Hwy. CA 90045) and deliver it to the destination in Long Beach.

Kales Finland and GHA invoice airline directly. Airline invoices FREJA via IATA's Cargo Accounts Settlement System (CASS). This invoice includes charge of Norwegian, fee of haulage contractor, terminal fees and commission of Kales. Proof of delivery is also sent to FREJA and further used in invoicing purposes or as a proof for any misconducts or obscurity. FREJA's customer will be invoiced based on the documents received and based on the agreed price entered in the ERP system.

## 5.2 Measure

The attributes and metrics used for measuring process performance were based on SCOR model. This increased validity and reliability of the metrics. Attributes were *Reliability*, *Responsiveness* and *Costs*. For reliability attribute the level 1 metric (KPI) was *Perfect order fulfilment rate*. The level 2 metric was *Delivery performance to customer commit date*. For responsiveness, the level 1 metric (KPI) was *Order fulfilment cycle time in days*, which indicated the time from receiving order to final delivery of the shipment. For costs attribute the level 1 metric (KPI) was *cost of service sold (€)*. Responsiveness and costs

were determined through three example cases where costs were calculated for both current and improved process.

Collection of performance data was done through interviews and enquiries. Data collection plan was created to indicate strategy for data gathering as well as to define the scope and progress of measuring. Data collection plan shows who collected data, what kind of data was collected, when it was collected, why it was collected and how it was collected. Data collection plan also defines data gathering procedures for the future measurements. Table 4 presents the data collection plan for air freight process.

Table 4. Data collection plan (Baxter 2015).

<b>DATA COLLECTION PLAN</b>					
<b>Who</b>	<b>What</b>		<b>When</b>	<b>Why</b>	<b>How</b>
<i>Responsible</i>	<i>Attribute</i>	<i>Type of data</i>	<i>Week (2016)</i>	<i>Metric (KPI)</i>	<i>Collection method</i>
Researcher	Reliability	Qualitative	47	Perfect order fulfilment (%)	Enquiry to air freight department
Researcher	Responsiveness	Qualitative	48	Order fulfilment cycle time	Enquiry to GSA and air freight department
Researcher	Costs	Qualitative	49	Cost of Service sold (€)	Enquiry to GSA and FREJA's personnel

### 5.2.1 Reliability

Perfect order fulfilment rate was calculated from the delivery performance to customer commit date in the process. If the shipment was delivered on-time but with defects, it was considered as not on-time delivery. The rate was estimated from the number of on-time deliveries and number of orders or attempts to fulfill order on-time. Early deliveries were also counted as on-time deliveries even though in some cases these might cause unnecessary increase in stock levels. To calculate the delivery performance following formula was used:

$$\text{On-time delivery \%} = (\text{number of orders delivered on-time} / \text{total number of orders}) * 100$$

Since the air freight department was recently established, sample was formed by calculating all the export orders received between September and December and creating an estimate for annual number of shipments. Annual number of on-time deliveries was also formed from an estimation based on export shipments delivered on-time between September and December 2016.

$$\text{On-time delivery \%} = (1445 / 1700) * 100 = 85 \%$$

The current air freight process has perfect order fulfilment (%) rate of 85. Current export air freight process was considered as 85 percent reliable. Six Sigma measure DPMO was also calculated for the reliability attribute. It was calculated with following formula:

$$\text{DPMO} = ((\text{Total Defects}) / (\text{Total Opportunities})) * 1,000,000$$

DPMO for the reliability attribute is:

$$\text{DPMO} = ((255) / (1700)) * 1000000 = 150\ 000$$

This means that from million shipments 150 000 shipments (15 percent) is delivered under the required service level.

### 5.2.2 Responsiveness

Order fulfilment cycle time was calculated for the example shipment on route *Vaasa-Copenhagen Airport, CPH (gateway)-Los Angeles International Airport, LAX*. Cycle time was *four days*. Cargo is delivered to Los Angeles in three days (according to Kales Finland) but additional day was added due necessary delivery arrangements after order and due unpredictability of the time required for unloading and customs inspections:

- *First day* includes receiving order, negotiating freight rate, booking cargo space and arranging pick-up. Shipment is collected from Vaasa in the first day.
- In the morning of *second day* shipment arrives to terminal in Vantaa. In afternoon, it is loaded to international truck. Truck is shipped from Turku to Stockholm with evening ferry.
- In the morning of *third day* ferry arrives to Stockholm. In the same evening shipment is unloaded at Copenhagen airport where it is consolidated to ULD along with other shipments.
- *Fourth day* includes the flight to LAX, unloading of aircraft, receiving customs release and placing shipment available for collection.

### 5.2.3 Costs

Cost of service for example shipment (VSA-CPH-LAX) was calculated based on the air freight rate (1,55 €/kg), price for domestic delivery from Vaasa to Vantaa (90 €), terminal fee of Kaukokiito (18 €), and price for terminal and security procedures of GHA (170 €). This information was given by FREJA and Kales Finland.

**Cost of service sold (€) = 90 € + 18 € + (1,55 € \* 1100 kg) + 170 € = 1983 €**

Cost of service for example shipment (Vaasa-CPH-LAX) was 1983 € All-in.

#### 5.2.4 Data display

Current KPI values are shown in table 5. Target values for process improvement were defined based on current values. Value from improvement for *Perfect order fulfilment (%)* will be determined in April 2017 after the first quarter of 2017. Target values for *Order fulfilment cycle time* and *Cost of service sold* metrics were applied to all the orders operated through improved process.

Table 5. Data display scorecard.

Attribute	Level 1 metric	Current value	Target value
Reliability	Perfect order fulfilment (%)	85 %	95 %
Responsive-ness	Order fulfilment cycle time (CPH example)	4 days	5 days
Costs	Cost of service sold (€) (CPH example)	1983 €	-10%

#### 5.3 Analyze

Gap between current performance and process capability was analysed with the value-added process chart (figure 9). It showed which of the process phases created value to process output, which did not add value and which were not required to add value.

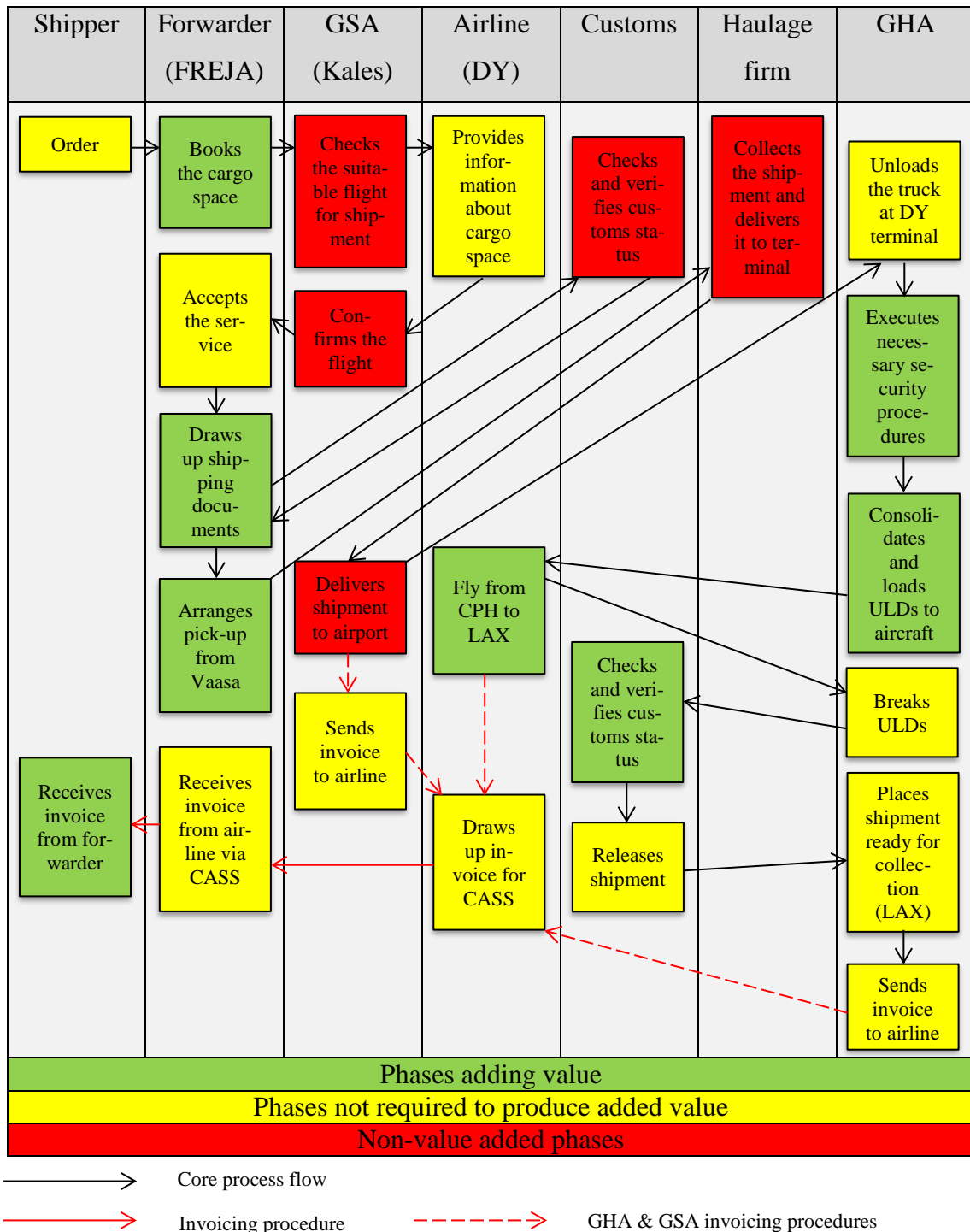


Figure 9. Value-added process chart.

Value added process chart showed that activities executed by GSA are mostly non-value adding, as are the activities of haulage firm. Activities of these two were the ones that

were examined further to find out solutions for minimizing their effect. One additional notice was that the process ends when the shipment is made ready for collection at the destination airport. This meant that final delivery was very rarely operated by FREJA. By operating final deliveries, FREJA could extend the process.

### 5.3.1 Selecting the problem to improve

The non-value adding issues that *value added air freight process chart* revealed were assessed in table 6. These were first assessed based on their *frequency* in air freight process, meaning how often issue is faced when completing the process. Then based on their *importance*, meaning how important phases issue includes in the air freight process, and finally based on *ease of fixing* the issue. *Total* points showed which of the issues should be fixed.

Table 6. Rating chart for selecting the most crucial problem to improve.

Issue	Frequency	Importance	Ease of fixing	Total
Not offering air freight services with final delivery	5	2	2	9
Buying services from GSAs	4	3	1	8
Lack of using own assets	5	4	4	13

Rate 1-5 (5=highest value)

*Not offering air freight services with final delivery* means that FREJA will not usually sell services that include final delivery to consignee. There was one good reason for this. Customers often demand that the importer of goods arranges the final delivery by road since they likely have some local haulage partner that they use in this kind of transports. Forwarders not necessarily possess such partnership to a local haulage firm in the destination country. This is because unlike forwarder, importer frequently uses services of local haulage firm and offers bigger volume to it and hence gains more affordable prices. It would require extensive increase of forwarder's worldwide network to gain more affordable transport prices than the importers.

*Buying services from GSAs* means that there were some phases that FREJA could handle by its own but is forced to use GSA's services. GSAs are named by airlines as their sales representatives in countries where airlines' do not have their own offices. In these countries, services of these specific airlines must be bought from GSAs. GSAs are independent companies, which means that they will gain commissions from selling airline's space to forwarders and other customers. If forwarder would decide to stop using GSAs as intermediaries in cargo space purchases, it would not be able to buy any space from airlines using GSAs which would dramatically limit forwarder's buying options. It is not easy to avoid GSAs because these represent so many airlines especially in small countries such as Finland. To minimize GSA's control in the air freight process, FREJA should find ways to use as much of their own resources as possible. One way would be negotiating trucking agreements with large airlines where FREJA would buy cargo space directly from airline and deliver shipments independently to gateway.

*Lack of using own assets* refers to fact that FREJA did not use its assets in the air freight process as much as possible. The most eminent indication of this was small use of FREJA's core competence: road transport resources. By integrating its road transport network to air freight process, FREJA could insource valuable phases. These were collection from consignor, using only own terminal for consolidation purposes and delivering shipments to gateway airports in Europe. As the table 6 shows, this gained highest total points from the three issues.

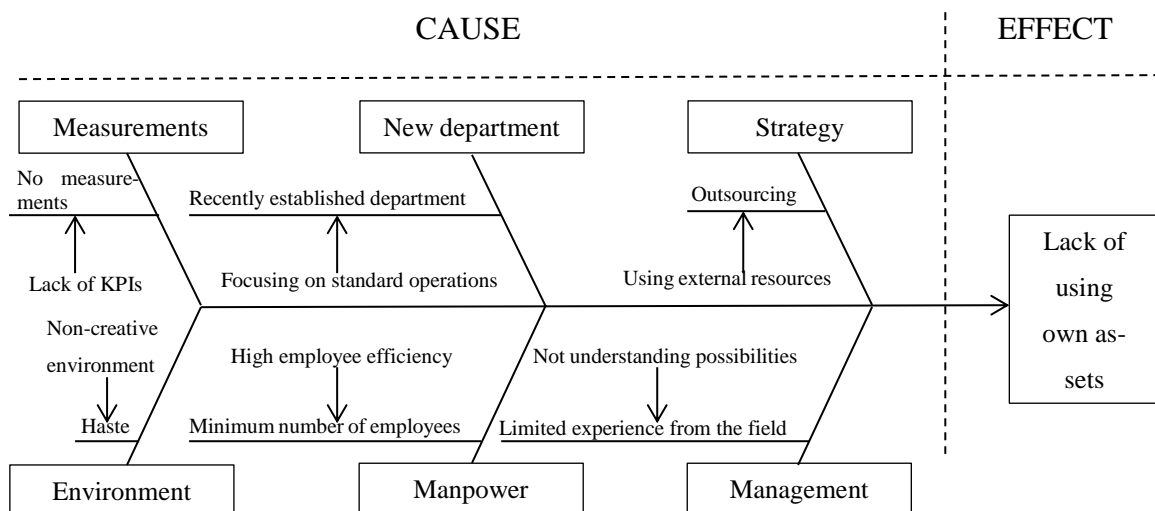


Figure 10. Cause and effect diagram (fishbone) for inefficient use of assets.

Cause and effect (fishbone) diagram in figure 10 shows the reasons for the lack of using own assets in the process. First major cause was *measurements* where the lack of KPIs and uncertainty of value added productivity of assets was consequence of not measuring the process. *New department* refers to fact that there were no improvements made in the process since department was focusing on creating and sustaining standard operations due only recent establishment. Outsourcing was the main *strategy* for providing air freight services. This meant that services were operated with external resources. *Management* had limited experience from combining air freight with own road transport resources. This caused lack of practical knowledge from the field. Management did not necessarily understand all the possibilities to improve processes and activities.

*Manpower* means that there was no time to plan and execute improvements due high employee efficiency caused by operating only minimum number of employees that were needed to run the department. *Environment* refers to lack of innovations which was a cause of non-creative environment and general haste in the working environment. This was highly related category to manpower category. Conclusion from the fishbone diagram was that the most fundamental cause for lack of using own resources was the fact that department had operated only four months. There had not been enough time to adjust resources properly.

### 5.3.2 Selecting the solution for the problem

When the problem to improve was selected, next question to answer was: in which scale the use of own resources and further insourcing of road transport activities should be done? It was decided that from now on international haulage from Finland to Europe would be handled only with FREJA's own trailers. However, it was unclear how domestic collections from consignors would be operated. Table 7 shows three solutions each representing different scale of insourcing. These were assessed based on *ease of implementing* the solution, solution's *value to customer*, *cost* to implement, and *totals* determining the *rank* of each solution.

Table 7. Rating chart for selecting the most efficient solution.

	Ease of im- plementing	Value to customer	Cost	Totals	Rank
Outsource all collections to domestic haulage firm	5	2	2	9	<b>3</b>
Use only own trailers in all collections	2	4	3	10	<b>2</b>
Use both domestic haulage firm and own trailers in collections	4	4	4	12	<b>1</b>

Rate 1-5 (5=most preferred)

*Outsource all collections to domestic haulage firm* would have been the easiest way to reduce the lack of using own resources. This would have meant that domestic haulage partner would pick-up the shipment and deliver it to their terminal in Vantaa from where it would be loaded to FREJA's international truck. FREJA's domestic haulage partner is Kaukokiito which is one of the biggest in its industry. They have the resources to handle all the collections. However, by using Kaukokiito in all domestic collections, FREJA would still outsource large part of the process's road transport activities. Value to customer would stay at low level because from their perspective FREJA would still use unnecessary intermediaries that decrease transparency. From internal perspective, FREJA would still have to rely on external parties to operate their collections faultlessly. In addition, easiness to operate will almost always come with high costs. Collection costs would have become much higher for FREJA if they would only use Kaukokiito rather than own fleet of trailers. This is because it is not affordable to use Kaukokiito in large shipments. That is why this solution was ranked only as the third best option.

*Use only own trailers in all collections* would have been ideal situation but not practical. This would have required extensive amount of work from traffic coordinators to operate all the collections by only using own fleet. It would inevitably increase the lead time from

order to collection since there is not suitable trailers always available for relatively small shipments. In addition, if these shipments would be picked up no matter what to reduce the lead time, it would dramatically increase costs. Practically thinking it is not reasonable to pick up every shipment with own fleet. That is why ease of implementing and cost categories gained low points. Value to customer gained four points because of minimizing intermediaries and increasing transparency. In theory, value to customer category would have gained full points but because customers would face either long lead times or increased costs category gained only four points. This option was ranked second best.

*Use both domestic haulage firm and own trailers in collection* is the way FREJA operates its road transports. This so called ‘*hybrid*’ solution takes advantage of two different ways to collect. When it is possible, shipment is picked up with own fleet. When it is not reasonable, collection is bought from Kaukokiito. This will enable the highest level of price/efficiency relation. Ease of implementing gained four points because collections of air freight must be integrated to road transport management system. This should not be difficult but it requires some adjustments. Value to customer and cost categories gained four points because of high level of costs/efficiency relation. It did not gain full points due use of subcontractor. This option was chosen to be the way for insourcing road transport activities.

#### 5.4 Improve

New service created with insourcing of road transport activities is called *road feeder service*. Feeder is widely used term in container shipping industry. It refers to activity where large transoceanic container ship discharges its cargo to large transshipment port, like port of Hamburg. From there cargo is reloaded to feeder vessels, which are smaller container ships that can access smaller ports. These feeder vessels take the cargo to final port of destination. (Unifeeder 2016.) Idea is similar in road feeder service. In export transports air cargo is picked up from consignor by a truck, which in this case represents feeder vessel, and delivered to actual airport of departure. In import transports air cargo

is transported to arrival airport by plane and then picked up by a truck and delivered to actual place of delivery. Some airlines offer road feeder services with individual flight numbers to airports that they do not serve by air (Sales 2013: 6).

5.4.1 Process descriptions for improved air freight process

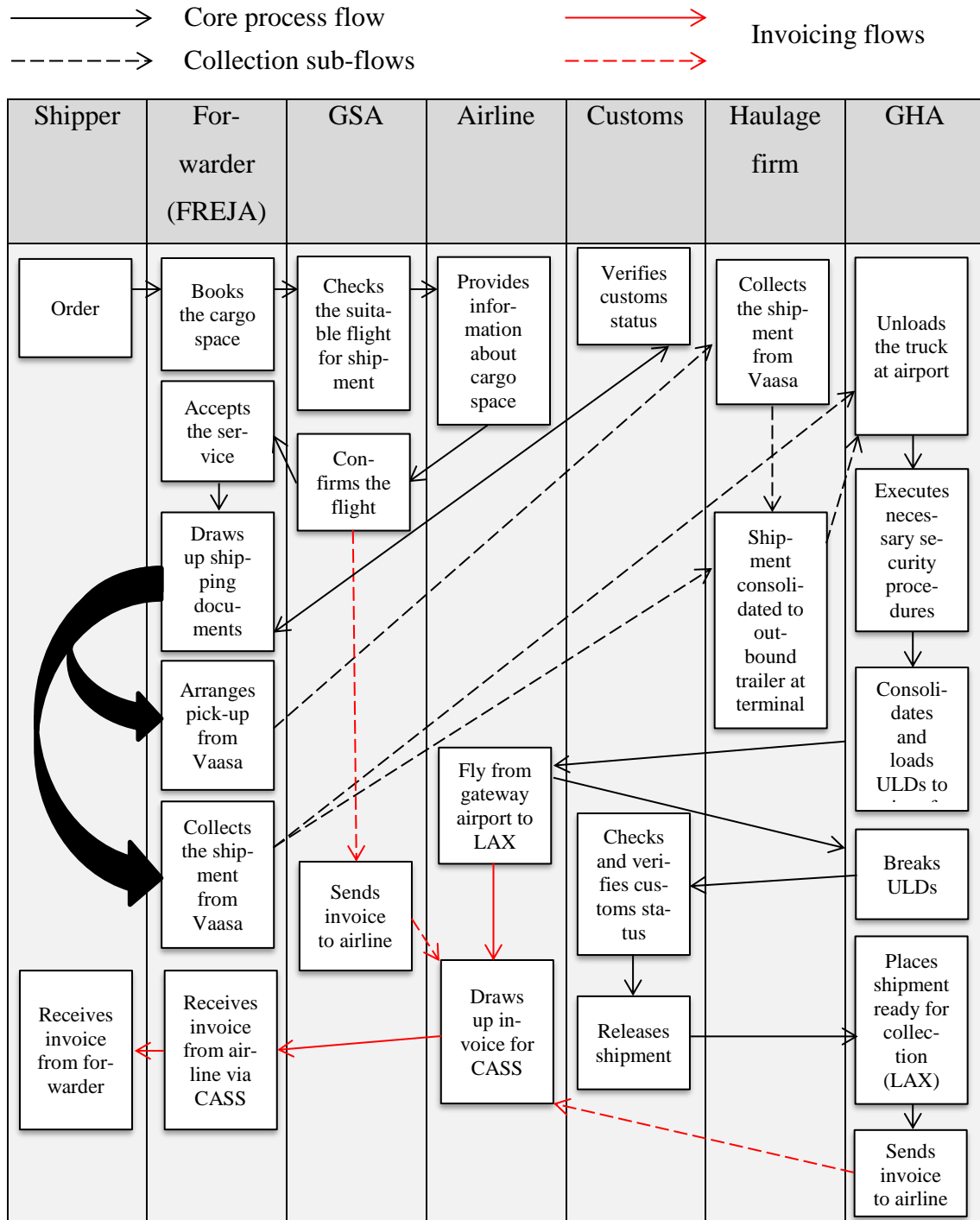


Figure 11. Improved air freight process chart.

Figure 11 shows the improved air freight process. When FREJA has accepted the service bought from GSA and formed shipping documents, it collects the shipment from Vaasa. As the dash lines indicates, there are two ways to collect the shipment. One is to use own fleet of trailers. In this option traffic coordinator arranges FREJA's own truck to collect the shipment. When the shipment is loaded, truck either goes directly to gateway airport (after other loadings) or it unloads the shipment to Kaukokiito's terminal in Vantaa where it is re-loaded to international truck heading to gateway. If there is a truck near the collection point with destination close to gateway, there is no need to unload the shipment to Vantaa terminal. If there is not such truck available, then some truck near the collection point going to Helsinki area picks up the shipment and delivers it to Kaukokiito's terminal.

The other way to collect the shipment is to order collection from Kaukokiito. They will pick it up and deliver it to nearest regional terminal. From there the shipment is consolidated to line-haul truck going to Vantaa terminal. Kaukokiito announces FREJA when the shipment is at Vantaa and ready to be loaded to outbound trailer. Depending on the collection point, shipment is at Kaukokiito Vantaa terminal in the same day or the next weekday from the order. For example, shipment is delivered from Vaasa to Vantaa on the next weekday from the order.

In both ways, delivery to gateway is operated with FREJA's own truck. Which option to use for collection depends on availability of trucks and size of the shipment. When the shipment size increases the more affordable it becomes to use FREJA's own truck for collection rather than Kaukokiito's services.

In figure 12, the improved air freight process is described from more internal perspective. When air freight department (AFD) has entered shipper's transport order to ERP-system, they will release the ERP-booking to the use of road traffic department (RTD). It becomes visible in the ERP's transport management application for traffic coordinators. Now it is handled as a regular road transport booking. Based on the traffic coordinator's decision,

shipment is collected with own truck or with Kaukokiito. Orange arrow indicates procedure needed for collection with own truck while blue arrow indicates procedure of Kaukokiito. Traffic coordinator will also book a ferry place for the trailer or for the truck and trailer combination.

AFD forms shipping documents along with case labels. Case labels are sent to GHA at the gateway or to Kaukokiito, if shipment is handled through their terminal (this is indicated by red dash line). If shipment is handled through Kaukokiito's terminal, traffic coordinator sends loading list (and unloading list if necessary) to Kaukokiito determining when and in which trailer the shipment is loaded. Trucking company, meaning FREJA's trailer and trucking subcontractor, will execute the final delivery to gateway airport.

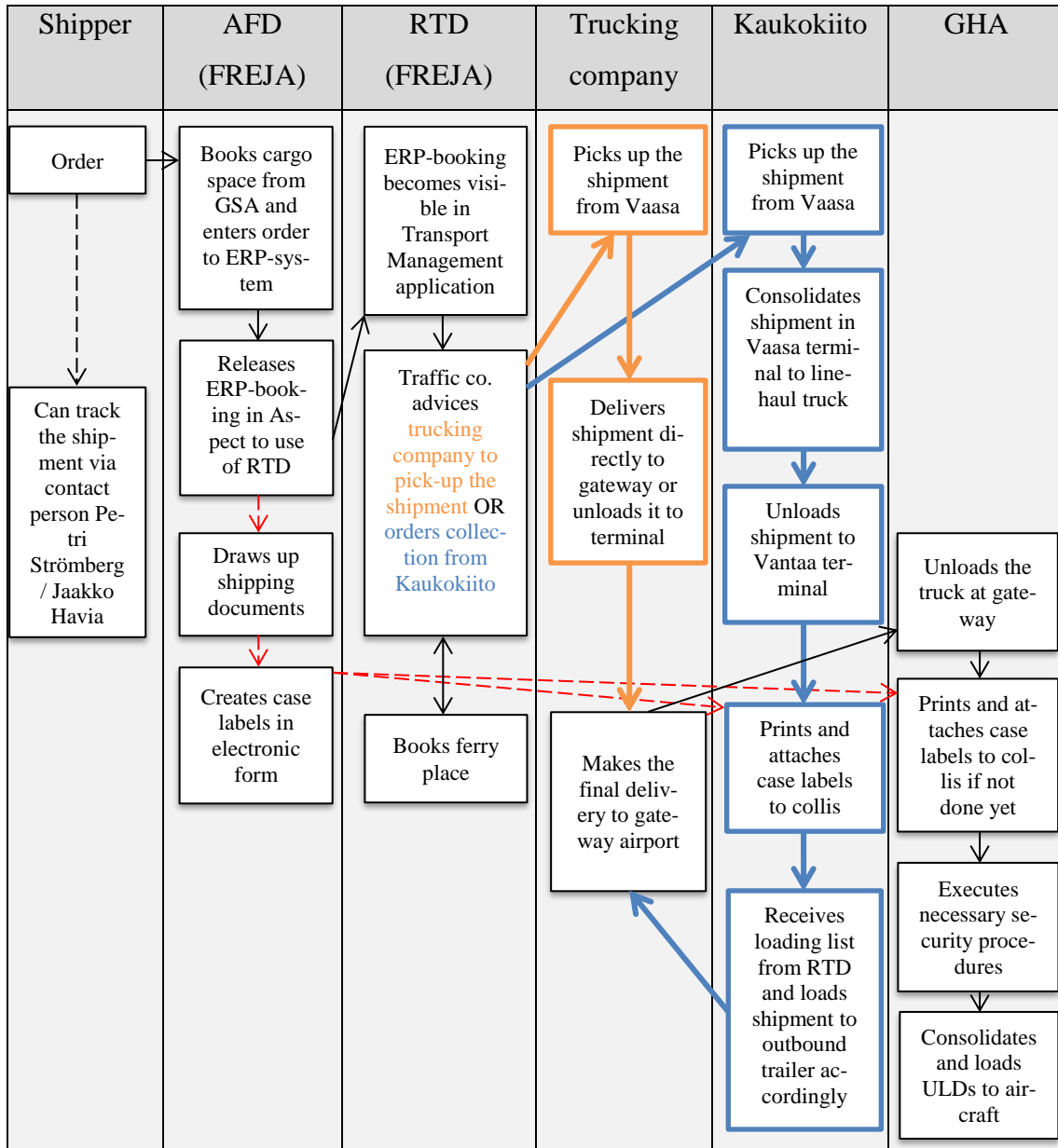


Figure 12. Internal view of the air freight process chart.

#### 5.4.2 Example cases

Three example cases were chosen to determine the difference between current process and improved process. The example shipment (2 EUR-pallets) was used in each of these cases. In each case, collection was from Vaasa and delivery to LAX airport. Vaasa was chosen as place of origin due its strong industrial appearance. LAX was chosen as place of delivery since it is the largest airport in California and because most of the air freight delivered by road to gateways in Europe are directed to North-America. The three cases were following:

- Vaasa – Copenhagen Airport, CPH (gateway) – Los Angeles International Airport (LAX)
- Vaasa – Frankfurt Airport, FRA (gateway) – Los Angeles International Airport, LAX
- Vaasa – Amsterdam Airport Schiphol, AMS (gateway) – Los Angeles International Airport, LAX

While the shipment, place of origin, and place of delivery were same in each case the gateway airport differed. These three airports were chosen because those are the most commonly used gateways when air freight chain includes trucking of goods from Finland to Europe before flight. By comparing different routings with both processes, it was possible to get more valid results. The three cases were compared based on two KPIs used in *measure* phase. These were *order fulfilment cycle time in days* and *cost of service sold (€)*. Information for KPIs was acquired through enquiries to FREJA and GSAs. Difference between current and improved process was assessed by comparing each case separately. This provided six different results. Domestic pick-up was operated with Kaukokiiito in both current and improved process. Most probably FREJA would have achieved lower costs in some of the cases by using own trailers from pick-up to delivery.

Results from comparing each case separately are shown below:

- **Vaasa – Copenhagen Airport, CPH (gateway) – Los Angeles International Airport (LAX)**

- Current process:
    - *Order fulfilment cycle time: 4 days*
    - *Cost of service sold: 1983 €*
  - Improved process:
    - *Order fulfilment cycle time: 5 days*
    - *Cost of service sold: 1868 €*
- **Vaasa – Frankfurt Airport, FRA (gateway) – Los Angeles International Airport, LAX**
    - Current process:
      - *Order fulfilment cycle time: 6 days*
      - *Cost of service sold: 2353 €*
    - Improved process:
      - *Order fulfilment cycle time: 6 days*
      - *Cost of service sold: 2205 €*
  - **Vaasa – Amsterdam Airport Schiphol, AMS (gateway) – Los Angeles International Airport, LAX**
    - Current process:
      - *Order fulfilment cycle time: 11 days*
      - *Cost of service sold: 2786 €*
    - Improved process:
      - *Order fulfilment cycle time: 11 days*
      - *Cost of service sold: 2737 €*

With the current process on route **Vaasa–CPH–LAX** *cost of service sold* was 1983 €. When operating with the improved process *cost of service sold* was 1868 € meaning that FREJA would save 97 euros per shipment compared to current process. In ten example shipments, FREJA would save 970 € with improved process. In addition, FREJA can

provide almost the same cycle time with the improved process than with the current process. Current process achieved *order fulfilment cycle time* of 4 days and improved process 5 days.

With the current process on route **Vaasa–FRA–LAX** *cost of service sold* was 2353 €. Through improved process the cost was 2205 €. This means that FREJA saves 148 € per shipment by using improved process. In ten example shipments, savings would be 1480 €. *Order fulfilment cycle time* was 6 days in both processes.

In example case Vaasa-AMS-LAX, routing includes road transport from JFK airport (New York) to LAX. This inevitably increases delivery time. Cycle time is same for both processes, 11 days. *Cost of service sold* with current process was 2786 €. By using improved process costs were only 49 € less. In ten example shipments, improved process would gain 490 € lower costs than the current process.

It was difficult to create valid comparison between air freight cases since prices for cargo space vary largely. If aircrafts are full, then prices are up and vice versa. Different airlines have also different security fees at gateways. Difference in price for stackable cargo and non-stackable cargo can be huge or sometimes there is no difference at all. Prices vary also depending on whether cargo space is bought from passenger aircraft or all-cargo aircraft, or if the flight is direct or if there are stopovers on the way. Cost calculations in example cases are not directly comparable but those give an estimate about the difference between processes.

#### 5.4.3 Implementation of the improved process

Cost calculations showed that costs can be reduced, if the improved process will be implemented. With small shipments, such as the example shipment the cost reductions are moderate. However, when shipment sizes are bigger or road transport is handled only with FREJA's trucks, reductions grow. Figure 13 shows the force field analysis for the

implementation of the road feeder service. This was done to validate the implementation decision.

Weight	Driving force		Restraining force	Weight
5	Management gives support	Implement road feeder service	Lack of time to implement	3
4	Pressure from market "do more with lower price"		Upset business partners by insourcing	2
2	Increase volume and revenues		Risk of failure	2
2	Increase market share and gain new customers		Small financial benefits from implementation	2
4	Increase productivity of own resources		Need to integrate RFS operations to ERP system	2

Rate 1-5 (5=highest)

Figure 13. Force field analysis for the implementation of road feeder service.

There were five driving forces and five restraining forces listed in the force field analysis. Each force had its weight defined to provide total score that was used to determine whether road feeder service should be implemented. From restraining forces *lack of time to implement* gained highest weight factor. Employees' workloads may increase when organization is growing. This affects people's desire to implement something new that will not benefit them directly. However, this force gained only three points because implementation is not predicted to require large increases in workloads and because organization's employees can see the benefits of innovations in long-term. *Upset business partners by insourcing* was not considered as powerful force since firms are always looking for opportunities to increase their own profitability. *Risk of failure* gained only two points since the harm from failure was not considered as severe and because probability of failure is relatively small. Issues that could lead to failure of RFS are such as decrease in

perfect order fulfilment rate, large increase in delivery times, and unsuccessful implementation of RFS.

*Small financial benefits from implementation* refers to situation where personnel's workload is increased and operating methods adjusted accordingly to RFS but profitability hardly increases. This gained low points since early calculations proved that it is possible to make considerable savings with RFS. Last restraining force was *need to integrate RFS operations to ERP system*. This refers to the need of modifying ERP system in a way that documentation, transport management and invoicing of RFS can be executed effectively in the system. However, this was not considered as significant force since early interviews of FREJA's administration showed that ERP system is capable to meet the challenge.

Highest points from driving forces was given to management's support. This was justified with the fact that management of air freight department suggested that air freight process should be improved. *Pressure from market "do more with lower price"* and *Increase productivity of own resources* gained almost full points. Market pressure has affected transportation industry for a long time. It mostly creates pressure to new businesses who are aiming to gain foothold in the market, like FREJA's air freight services. Resource productivity increase is highly powerful force since it is the problem in the current air freight process. It did not gain full points because air freight can be operated with the current process even though there is lot of room to improve the cost-effectiveness. *Increase volume and revenues* and *Increase market share and gain new customers* are obvious targets for almost every business. Because of it and because the improved process will not necessary lead to these issues, those were not rated high.

Restraining forces gained total points of 11 while driving forces gained 17. This analysis clearly supported the fact that RFS should be implemented. Implementation plan was made based on results from the analysis and calculations. Implementation plan for the road feeder service was formed as in table 8. Table shows date for action, describes action to be taken and person responsible of it.

Table 8. Implementation plan for the road feeder service.

Date	Action	Responsibility
Week 10	Present the results to FREJA	Researcher
Week 11	Adjust process as per feedback	Researcher
Week 13	Hand over the material needed for implementation	Researcher
Week 14	Create IT/ERP infrastructure for RFS	Administration
Week 16	Handle a test shipment through the new process	Air freight department
Week 18	Make final adjustments to fit the new process to operations	Air freight department/Administration/Road traffic department
Week 20	Make the full implementation	Air freight department

This plan will be used to drive successful implementation of the road feeder service. After finishing the thesis, results from it are presented to FREJA. This is done in a meeting accompanied with FREJA's management from both road and air traffic departments. After presenting the results and getting feedback from FREJA, process will be adjusted accordingly. After adjustments and FREJA's approval, all the materials will be handed over to FREJA for further implementation. Administration creates necessary modifications to ERP system ensuring functional IT infrastructure for RFS. This for example includes correct invoicing procedures and procedure for making air freight bookings visible in road transport management application. When the IT infrastructure is created, new process is tested by handling a test shipment through it. Handling of a test shipment can reveal issues needed to be improved. After this, improved process is finally adjusted to fit in the FREJA's operations. Now the final implementation of RFS can be made.

## 5.5 Control

By documenting the phases and results of the research it was possible to assure that the business goals of the thesis were accomplished. Documentation was made through figures, tables and text. By continuing documentation in the future, quality and costs can be controlled in the process. Main tool for this is a process control plan, which restricts the

improved process and operations for taking steps back. Process control plan for improved process is showed in table 9.

Table 9. Process control plan.

Process	Evaluation measure-ment technique	Process tolerance	Sample size and frequency	Control method	Reaction plan
Export air freight process	Profit margin ratio calculation	Max. deviation -2%	All export orders monthly	Running data from ERP	Assessing price level and costs
Export air freight process	On-time delivery % calculation	At least 92% of orders on-time	All export orders monthly	Running data from ERP	Finding the root cause
Export air freight process	Employee productivity calculation	Min. 10% higher than in 4 <sup>th</sup> quarter of 2016	Assessing personnel of AFD quarterly	Quarterly reports	Personnel training and work distribution

Process control plan emphasizes three issues to consider for maintaining quality in the improved export air freight process. First was measuring the profit margin ratio in the process. Process tolerance was determined by calculating average profit margin ratio for export orders operated in 2016. A five percent increase was set to 2016's profit margin ratio. This was then used as the target ratio for the year 2017. Based on the target ratio, the maximum tolerated deviation was calculated. Average profit margin ratio for each month can negatively deviate maximum of 2% from target ratio. Upward deviation from the target ratio is obviously acceptable. Data for the calculation is acquired from the ERP system. If deviation is negative and exceeds 2% limit value, price level and cost factors are immediately assessed.

Second issue was measuring the number of on-time deliveries. This was done by first calculating on-time delivery percent for year 2016 (85%). It was supported with calculation of DPMO (150 000). Target on-time delivery percent for the improved process was set to be 95%. It was decided that 92 % of all export orders in each month must be delivered on-time. This means DPMO rate of 80 000. Data for assessing the on-time delivery % is acquired from the ERP system. If monthly value would be under 92 %, this would lead to actions to find out the root cause. This includes tracking down the parties and operations that have caused major share of the late deliveries.

Third issue was value added productivity per employee. It is used to assess the internal profitability. Value added productivity measures how much value department produces. Formula for this measure is:

**Value added productivity per employee** = (Operating profit € + Total employee costs €) / Total Number of Employees in FTEs

Value added productivity was set to be measured quarterly from the quarterly reports and statements. Target level was set to be at least 10 % higher than in the last quarter of 2016. Process tolerance will be adjusted during the 2017 since the air freight department only operated in the 4<sup>th</sup> quarter of 2016. If the value is lower than 10%, it will be improved by personnel training and work distribution to find needed balance and efficiency in the department. Personnel of the department is highly involved in conducting of reaction plan.

It is recommended that similar control plan is used further in other processes of the organization to measure progress and maintain high quality. By discovering problems and variation in processes, it is possible to improve. This should be done in close cooperation with the personnel of organization. Feedback from personnel should be used to find solutions to issues causing problems and bottlenecks.

## 6 ANALYSIS AND CONCLUSIONS

This research aimed at answering to a question: Can the current export air freight process be improved with DMAIC cycle? DMAIC cycle was chosen because the current export air freight process was supposed to be improved in a way where client organization's resources would be in better use. With DMAIC, it was possible to detailly and systematically recognize and analyse different process steps to find the solution. Further, the documentation created during the cycle can be used in future improvement projects. DMAIC cycle is used in process improvement projects in many different industries. Result of the research proved that DMAIC cycle can be efficiently used also in transportation industry to improve transportation processes.

### 6.1 Key findings

Usability of the improved process in providing air freight services was confirmed in the empirical part of this research. This will be also validated by FREJA in near future. The improved process was created to handle shipments between 100 kg/0,4 ldm – 24 000 kg/13,6 ldm. Example shipment that was used in the research was 2 EUR-pallets with 1100 kg and 0,8 ldm. This was chosen because by using small shipment it was possible to provide “at least” results. It is predicted that when shipment size increases so the benefits from the improved process. Lowest costs will be achieved when air cargo is consolidated actively to FREJA's road transportation network. This means handling whole transportation chain from consignor to gateway with FREJA's weekly FTL, LTL, and groupage trucks. In best case scenario, air cargo shipment can be fitted into one of FREJA's weekly FTL-trucks and delivered directly to gateway before unloading the actual FTL-load.

Process improvement reduced intermediaries, streamlined the process, and increased the use of FREJA's own resources. This increased transparency and cost-efficiency of the process. To make the process more efficient the key issue was to increase company's role

in the transportation chain by using own core competence as much as possible. Improved process enables either direct or indirect increase in the gross profit. Direct increase would be achieved by operating air freight services with the current price level but with lower operating costs. Indirect increase would be achieved by offering more affordable freight rates to customers while increasing volume and eventually gross profits.

Table 10. Individualized scorecard.

Attribute	Level 1 metric	Current value	Value with improved process	Current value changed
Responsiveness	Order fulfilment cycle time ( <i>CPH example</i> )	4 days	5 days	+1 day
Responsiveness	Order fulfilment cycle time ( <i>FRA example</i> )	6 days	6 days	+/- 0 days
Responsiveness	Order fulfilment cycle time ( <i>AMS example</i> )	11 days	11 days	+/- 0 days
Costs	Cost of service sold (€) ( <i>CPH example</i> )	1983 €	1868 €	-115 € (-5,8 %)
Costs	Cost of service sold (€) ( <i>FRA example</i> )	2353 €	2205 €	-148 € (-6,3 %)
Costs	Cost of service sold (€) ( <i>AMS example</i> )	2786 €	2737 €	-49 € (-1,8 %)

In table 10 the individual results are listed from comparing three example cases with both current and improved processes. Results showed that responsiveness is nearly at the same level in both processes. Costs are significantly lower in CPH and FRA examples than in AMS example. This is most probably a cause of the fact that FREJA's traffic to Germany and Denmark is much more active than to Netherlands. Larger volume lowers the operating costs and vice versa.

Table 11. Overall scorecard.

Attribute	Level 1 metric	Current value (avg)	Target value (avg)	Value from improvement (avg)
Reliability	Perfect order fulfilment (%)	85 %	95 %	
Responsiveness	Order fulfilment cycle time	7 days	8 days	7,33 days
Costs	Cost of service sold (€)	100 %	- 10 %	-5 %

Table 11 shows the overall results from the process comparison. Reliability attribute and perfect order fulfilment rate of the improved process will be calculated during 2017. Responsiveness attribute with the order fulfilment cycle time metric had an average value of seven days with the current process. It was predicted that this would be increased by one day when using the improved process. However, estimation showed that the increase would be only 0,33 days (7 hours and 55 minutes). Trucks that are operated by GSAs are usually direct deliveries from cargo terminals to gateways while FREJA uses LTL and groupage trucks. It is possible that LTL and groupage deliveries increase the fulfilment time when transport chain includes many different unloading places. Costs attribute with cost of service sold as the metric, was set to decrease ten percent with improved process. It was shown in the study, that with small shipments this would not be the case when only five percent decrease was achieved. Five percent decrease will still bring considerable savings as shown in the table 12.

Table 12. Key statistics.

Average shipment costs (example shipments)	Shipments per year	Shipment costs per year with current process	Costs reduction percent with improved process	Savings per year with improved process
2374 €	1700	4 035 800 €	5 %	201 790 €

Average shipment cost with the current process is 2374 €, calculated with the three example shipments. Estimated amount of export shipments for 2017 is 1700. This means

that for 2017 shipment costs would be 4 035 800 € with the current process. When the average cost reduction through improved process was five percent, shipment costs would be 201 790 € lower making the total costs to be 3 834 010 € in 2017.

Common trend in the transportation business is that the annual revenue is increased by heavily increasing shipping volumes. This is also the most probable way to take advantage of lower air freight operating costs in FREJA. Reduced operating costs makes it possible to offer lower freight rates and by that attract new customers and increase the amount of shipments per year. If the cover ratio for export shipments is for example 20 percent, then the average shipment selling price with the current process is 2967,50 €. With 1700 export shipments, the turnover is 5 044 750 € per year with gross profit of 1 008 950 €. With improved process, average shipment cost is 2255,30 €. With 20 % cover ratio, the average selling price is 2819,13 €. This is 148,37 € less than with the current process. Turnover with improved process would be 4 792 521 € and gross profit 958 511 €. Due lower selling price, it would require 90 additional shipments with improved process to overcome the turnover that would have been achieved with the current process. However, this kind of addition in number of shipments would most probably be achieved due the lower prices.

If FREJA would use lower operating costs to increase gross profit per shipment, then the average selling price with both the current and improved process would be 2967,50 €. However, cover ratio would increase from 20 % to 24 %. Turnover per year would be the same 4 845 000 € with both processes but gross profit would be 201 790 € (1 210 740 €) higher with the improved process. In next five years, company would earn 1 008 950 € more with the improved process than with the current process.

It should be considered that the results are just estimations and can vary in practice. For example, not all export orders will be operated through improved process. In the other hand, many of the shipments are larger than example shipment making the cost reduction even larger. Altogether, it is expected that estimated cost savings will be achieved and even exceeded.

In addition, process improvement project cleared the way for further cross-functional projects. Departments are mainly examining issues from their own perspective and because of that decision makers may not consider the overall image. Joint projects between departments enhance cross-functional cooperation in organizations.

## 6.2 Development proposals

FREJA should adapt Six Sigma methodology more extensively into its organization. DMAIC cycle could be first used in improvement of import air freight process to create similar RFS service as in export air freight process. Further, Six Sigma methodology and DMAIC cycle as a process improvement methods could be spread to whole organization where all the relevant processes would be improved to eliminate variation. This could be then refined with continuous improvement methodology where processes are regularly assessed and improved.

Customers demand air freight services with delivery times varying from 2 days to 14 days. Customers prefer to choose longer delivery times and more unreliable security of delivery because these issues are highly tied to price. It is common that forwarders and airlines provide services that are divided to A, B and C classes per price, delivery time and reliability where 'fly as booked' is the fastest and most expensive option. To define the value of different road feeder services or air freight services, those could be classified to A, B and C classes where A -class would be the most fastest, reliable and expensive service. Example ABC-classification of air freight services for export shipments is showed in table 13.

Table 13. ABC-classification of air freight services.

Class	Collection method	Shipment size	Delivery time to gateway (CPH, FRA, AMS)
<b>A</b>	FREJA Express van	max. 430x190x175cm, 1500 kg	2-3 days
	FREJA FTL-truck	max. 1360x240x260cm, 24 000 kg	
	Outsourcing	max. 1000x240x260cm, 20 000 kg	
<b>B</b>	Kaukokiito (via terminal)	max. 399x240x260cm, 4999 kg	4-5 days
	FREJA-part load truck (may be handled via terminal)	min. 400x240x260cm, 5000 kg max. 1200x240x260cm, 20 000 kg	
<b>C</b>	FREJA groupage or part load - truck (may be handled via terminal)	max. 1200x240x260cm, 20 000 kg	5-9 days

Classes and their services would be named according to Norse gods and goddess. A-class would be **Express service** known as *ODIN* (the ruler of the gods). A-class would be the most expensive class designed for very urgent shipments. This service would also suit large shipments due FTL-truck collections. Shipments would be delivered directly from consignor to gateway airport without re-loadings. Flight would be chosen based on its reliability and fast delivery, not price. Small shipments would be collected by FREJA's express vans and largest shipments with FTL-trucks where the whole truck capacity is reserved for carrying the shipment. Deliveries for shipments under 10 loading meters and 20 000 kg would be purchased from airlines' road feeder service or handled with own FTL-truck depending which one is more affordable option. Delivery time from order to unloading at either Copenhagen, Frankfurt or Amsterdam airport would be 2 to 3 days.

B-class would be **Standard service** known as *TYR* (god of the skies). B-class would combine moderate price and speed of delivery. This service is designed for shipments that are urgent but do not require express delivery. If shipment is picked up by Kaukokiito, then it is delivered to Vantaa terminal where it is re-loaded to international truck. If FREJA collects the shipment with own truck, then shipment is either delivered directly

to gateway or re-loaded at terminal. Express service is only service where shipment will not be re-loaded in any circumstances. Affordable price is more emphasized than in Express service when choosing a flight. Not the fastest nor the cheapest flight is selected. Aim is to find the best combination of price and speed available. Kaukokiito is used for smaller shipments up to 4999 kg while FREJA-truck is used for shipments from 5000 kg to 20 000 kg. If shipment is larger than 12 loading meters and 20 000 kg, it is recommended to use FTL-truck and buy Express service. With FTL-truck, the price would be almost the same and delivery time much faster. Delivery time in Standard service is 4 to 5 days from order to unloading at either Copenhagen, Frankfurt or Amsterdam airport.

C-class would be **Economy service** (also called Economy class) known as *VÖR* (Goddess of wisdom). C-class would emphasize low price, which leads to long delivery time. Cheap price will also increase unreliability in the chain. This class is designed for non-urgent shipments up to 10 loading meters and 20 000 kg. If shipment is bigger than that, it is recommended to use FTL-truck and buy Express service. Shipment is collected with FREJA's groupage or part load -truck. Shipment may be re-loaded at terminal. Delivery time from order to unloading at either Copenhagen, Frankfurt or Amsterdam airport is 5 to 9 days.

### 6.3 Summary

This master's thesis was made as a commission for FREJA Transport & Logistics Oy. Aim of the thesis was to research how the current export air freight process can be improved through DMAIC cycle. Qualitative research was the main research method in this study. Research was limited to consider only export air transports from Finland to outside Europe. More precisely, only shipments that would be transported by truck to gateway airports in Europe and flew from there to destination countries. Export air freight process needed improvement because process was mostly outsourced and company's own resources used poorly.

Theoretical part was divided to two separate sections. First, the concept of business process improvement was handled. BPI was examined from the perspective of organizational performance enhancement. This was started by introducing the definitions of process and business process to give basis for the BPI concept. Introduction of the BPI concept was followed by a study of the Six Sigma concept as well as the DMAIC cycle. DMAIC cycle was chosen as the process improvement model for the empirical part. BPI concept was then supported with general introduction of KPIs and more precise introduction of SCOR metrics that were used in the empirical part.

Second section of the theoretical part considered air transportation. It was started with a brief introduction of transportation and air transportation. After this, the section focused on air freight. Air freight was discussed through six themes. These were, demand for air cargo, aircrafts, transport units, air cargo operators, air freight costs, and future in the market. Through these themes, it was possible to create overall image of the industry. Lastly a common export air freight process was comprised and explained to set basis for the empirical part. With this section, it was possible to reveal the strengths and weaknesses, as well as issues affecting to the supply and demand of the air freight.

Before the actual empirical part, chapter 4 presented the backgrounds of the research subject. It made the reader familiar with the client organization as well as helped better understand how and why the subject was chosen. It also introduced the starting point for the thesis as well as information gathering methods, important factors affecting to the process, and desired outcome.

In the empirical part, current process was taken under thorough examination to reveal the issues causing the limited use of own resources. Process was improved step by step as per the DMAIC cycle. First, the current situation and process was defined. After this, KPIs were set for the current process to reveal the problem areas in it. Attributes for the measures were reliability, responsiveness and costs. Main reason for variation and inefficient use of resources was outsourcing and by that linking number of intermediaries in the process. The best solution was to insource the phases from the process that are part of

company's core competence. This meant that FREJA would now on handle the road transportation from the consignor to the gateway airport. Based on this solution, the improved process was constructed. The improved process was measured with the same KPIs and compared to results gained with the current process. Results revealed that it would be possible to significantly reduce operating costs with the improved process and still offer evenly competitive service level. Estimated savings are hundreds of thousands of euros yearly. In the final phase of the DMAIC cycle a process control plan was drawn to ensure the quality in the improved process.

Research question for the study was: *Can the current export air freight process be improved with DMAIC cycle?* The more precise objective was to find a way to improve the export air freight process by using own resources in it. This was achieved by establishing the road feeder service with own road transportation network. Client organization found the improved process and road feeder service to be practically operational and noticed the considerable economic benefits that can be achieved with it. This was validated by the process charts, profitability calculations and other supporting documentation created during the DMAIC cycle and offered to FREJA.

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