CHALMERS

Information Flows in Product Development

Efficient cooperation between divisions of a production facility

Master of Science Thesis [Technology management and economics, TEKX08]

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Cover:
[Efficient islands within an inefficient ocean, see page 1]

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Abstract

At Saab Electronic Defence Systems in Göteborg (OEG), a Lean initiative has been going on since 2006. As an effect of the Lean initiative, the importance of flow efficiency was realised at the Mechanics and Environment division (PE). The division mainly develop mechanical parts and sub-systems of the products. In product development, the primary flow is information flow concerning products and projects. Hence, the information flow between PE and the other divisions at OEG was needed to be mapped and improved.

The purpose with this research was to find barriers against flow of information between divisions in a productions facility and to identify improvement areas that may contribute to the Lean work at the production facility. The research contributes to the Lean work at OEG. By interviewing 17 key persons within a base product development project, some distinct barriers were captured. These barriers were further investigated by means of a questionnaire to all design engineers at PE. To get a holistic view and to find improvement areas, observations and documents were studied. Through this case study, three research questions have been answered:

- How is the information flow between different divisions in a production facility, i.e. what is the distance, the link, the type of information and the frequency of the information shared between divisions?
- Which are the main barriers for the information flow between different divisions in a production facility?
- How can the barriers be reduced to improve the information flow between different divisions in a production facility?

It was found that the product development process and its related information flow is straight forward. However, the product development process also contains a complex change request process. Further, it was found that a great amount of information is shared via informal information sharing channels and that information can be difficult to obtain. The most significant barriers between PE and the other divisions are incomplete information, wrong amount of information, not understandable information and information received too late. The consequences are rework, time delays and overproduction. To reduce the barriers, it was found that standardisation is the critical and essential improvement area and that some supporting systems may need to be introduced. The recommended solutions are in line with OEG´s view on Lean and contribute to the Lean work at OEG. In a longer perspective, OEG may need to consider a change towards set based concurrent engineering and single-tasking.

KEY WORDS: Lean Product Development, Information Flow, Information Sharing, Information Quality, Managing Information.

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Karin Andersson and Emma Åkerlund

Göteborg, May 2012

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1. Introduction

The aim with this chapter is to give the reader a brief introduction to the research area, to the company and to why this research is important for the company. Further, the purpose of the study and the research questions are presented. The research questions will guide the authors and the reader through the research. Finally, limitations for the research are stated and an outline of the project is given.

To be and remain competitive, quality and efficiency are keys. Quality is a wide scope, but to generalise, it is about providing the customer with what he or she needs when he or she needs it (Bergman & Klefsjö, 2010). Close to the concept of quality, is the concept of Lean. Lean is a philosophy which puts the customer first by eliminating the activities that do not create any value to the customer (Liker, 2004). Modig & Åhlström (2011) take the concept of Lean even a bit further and describe the concept based on a view that many organisations has on Lean: a tool to become better, smarter, more productive and more efficient. According to Modig & Åhlström(2011), an organisation's activities can be seen as either a desert or as islands in an ocean. The islands represent different divisions within the organisation, and the ocean represents the organisation as a system. The state of an inefficient organisation is equal to a desert and the state of a Lean organisation is an organisation with efficient islands in an efficient ocean. Efficiency is defined as the time it takes for a task to be performed over the total lead time. If the organisation has efficient islands but lacks efficiency between the different islands, the condition of the organisation is efficient islands within an inefficient ocean. To make this type of organisation more Lean, the islands need to be connected (Modig & Åhlström, 2011).

Saab Electronic Defence Systems in Gothenburg (OEG) is striving to become Lean and has been working with a Lean programme since 2006. OEG describes their organisation as efficient islands in an inefficient ocean; thus, bridges needs to be built between the islands in order to achieve an efficient ocean. Figure 1 shows an example of efficient islands and their connections.

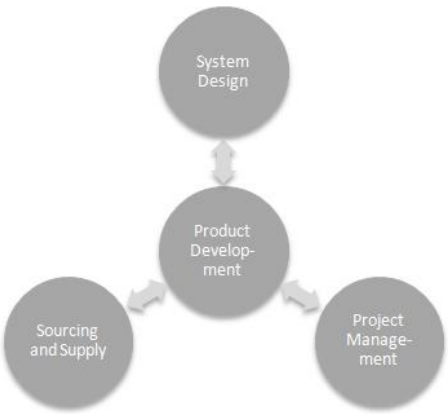

Figure 1. Efficient islands within an inefficient ocean. The circles represent the efficient islands and the arrows represent bridges that need to be built in order to become more Lean.

1.1 Company Background

Svenska Aeroplan Aktiebolaget (Saab), founded in 1937, is a company with a history of high technology. Saab started out as a company whose aim was to meet the needs for the domestic military aircraft industry in Sweden and Saab became an important supplier to the Swedish Air Force.

In the 1940's Saab began to manufacture cars and in the late 1960's Saab and Scania AB merged into Saab-Scania who produced trucks and buses. Except from these collaborations, Saab has participated in the development of the computer, missile and space industries in Sweden. Saab automobiles later separated from Saab and Saab-Scania demerged into Saab AB and Scania AB.

Nowadays, the focus at Saab AB is on future defence needs and a safer society. In order to meet the demands from the global defence industry, Saab AB has divided their operations into five business areas; Aeronautics, Dynamics, Electronic Defence Systems, Security & Defence Solutions and Support & Services (saabgroup.com, 2010), see Figure 2.

Figure 2. Saab AB's five business areas (saabgroup.com, 2010).

In 1956, Ericsson established a radar organisation in Göteborg, later known as Ericsson Microwave Systems. In 2006 Saab bought Ericsson Microwave Systems and renamed it to Saab Microwave Systems. This is nowadays known as Saab Electronic Defence System.

Saab Electronic Defence Systems has around 2500 employees in Sweden, Norway and South Africa and the turnover in 2010 was almost € 500 millions. At Saab Electronic Defence Systems, the focus is on solutions for surveillance, threat detection and location, platform and force protection and avionics. The product range covers airborne, land-based and naval radar systems, electronic support measures and self-protection systems. Saab Electronic Defence Systems also supply mission avionics and safety critical avionics computers. At Saab Electronic Defence System in Gothenburg (OEG), one of the products that is being developed and produced is the Giraffe AMB (AMB). AMB is a ground-based radar system intended for short- and medium range air defence (saabgroup.com, 2010).

1.1.1 The Lean Work at OEG

The Lean concept was introduced at OEG around the year 2008 by three driving spirits who saw its potential. In 2011, top management got involved in the Lean work which was an important and necessary development in the Lean work. The Lean work at OEG has a bottom-up approach where the employees propose suggestions how to become more Lean. Today, OEG is resource efficient but is striving to become both resource and flow efficient, i.e. to become an organisation with efficient islands in an efficient ocean. The strategy to become more Lean is to get everybody committed to the improvement work and to be open for changes. It is vital that the employees are encouraged to suggest improvement areas and that OEG considers the employees ideas. After an internal education of Lean in 2011, the importance of flow efficiency was realised among a number of employees and it was realised that the information flow between the divisions was not perfectly efficient.

1.2 Purpose

The purpose with this research is to find barriers against flow of information between divisions in a productions facility and to identify improvement areas that may contribute to the Lean work at the production facility.

In line with Modig & Åhlström´s (2011) findings bridges must be built between the different divisions in order for the organisation to become more flow efficient. The need for uninterrupted information flow extends to include also the flow between PE and PE's internal suppliers and customers. Therefore, it is of great importance to understand the information flow and to know who the internal suppliers and customers are. For that reason, visualisation is vital. Visualisation of the flow aims to give a holistic view of the information flow. This is necessary in order to identify possible barriers. Further, the visualisation provides information about the internal suppliers and customers, who they are and what they need. In the longer perspective, visualisation of the flow can contribute to better understanding of the organisation as a system. From this, the first and the second research questions are constructed.

> RQ1: How is the information flow between different divisions in a production facility, i.e. what is the distance, the link, the type of information and the frequency of the information shared between divisions?
>
> RQ2: Which are the main barriers for the information flow between different divisions in a production facility?

The improvement areas are the last to be highlighted and result in the third research question.

> RQ3: How can the barriers be reduced to improve the information flow between different divisions in a production facility?

1.3 Delimitation

An AMB project is the base project for this research, but to get a more general result also other projects are considered. This research is limited to the division level. The information flow in and out from the Mechanics & Environment division (PE) is analysed, see Figure 3.

Figure 3. Information flow in to and out from PE.

To understand how the information should flow, the predetermined processes are studied. Since the predetermined processes are not always strictly followed, it is how the employees actually work that is mapped. The first information flow that is analysed deals with customisation of base products. There is often a need for product changes during the project process. Therefore, the second information flow that is analysed is the change request information flow.

1.4 Outline

Chapter one presented the background for this thesis, the company background and the purpose of this research. The second chapter presents the method that was used.

Chapter three presents the frame of references. First Lean thinking in product development is presented, followed by managing information, information flows in product development and information quality. This is finally summarised in conclusions of frame of references.

In the fourth chapter, the empirical data collected is presented. Chapter four includes documents, interviews, questionnaires and observations both at OEG and from other sources.

The fifth chapter presents the analysis that is based on chapter three and four. The result of the analysis is presented in chapter six. Chapter seven concludes the result and summarises the answers to the research questions. Chapter eight discusses the method that is used for this research and the result.

2. Research Method

This research follows the principles of a case study research method. The aim with this chapter is to motivate why the case study research method is used, and to explain how it is used for this research. If the method is well performed, with adequate literature studies, methods, observations and analyses, a good and valuable analysis and result will be achieved (Yin, 2003).

Primary, there are two different areas of research methods; quantitative and qualitative. Depending on the characteristics of the research, either a quantitative or a qualitative research method is used. In a quantitative method, different areas can be measured or counted, whilst a qualitative method is holistic and deals with complexity (Lakshman, et al., 2000). A research that asks "how" and "why" questions are often complex in their nature and can consequently not be completed only with quantitative methods. Lakshman et al. (2000) therefore propose a mix of quantitative and qualitative methods to yield the most valid results. The advantage of using different methods is also mentioned by Karlsson (2009), who argues that multiple means of data collection increases the validity of the study.

When the research subjects vary in size and function, a qualitative research method is to prefer. A qualitative research method helps the researcher to understand the complexity of a system and the interactions between different variables within the system (Lakshman, et al., 2000). Since this research aims to find the interactions between sub-systems, it is a research of a qualitative method character.

2.1 Case Study

A case study is a research strategy which is used in social science and investigates topics such as decisions, organisations and processes. Further, the method is suitable when "how" and "why" questions are posted, when the researcher has little control over the events in the research and when the research has some real-life perspective (Yin, 2003). This research fulfils all three criteria; hence, the case study research method is used. Figure 4 shows the structure of the method that is used in this research.

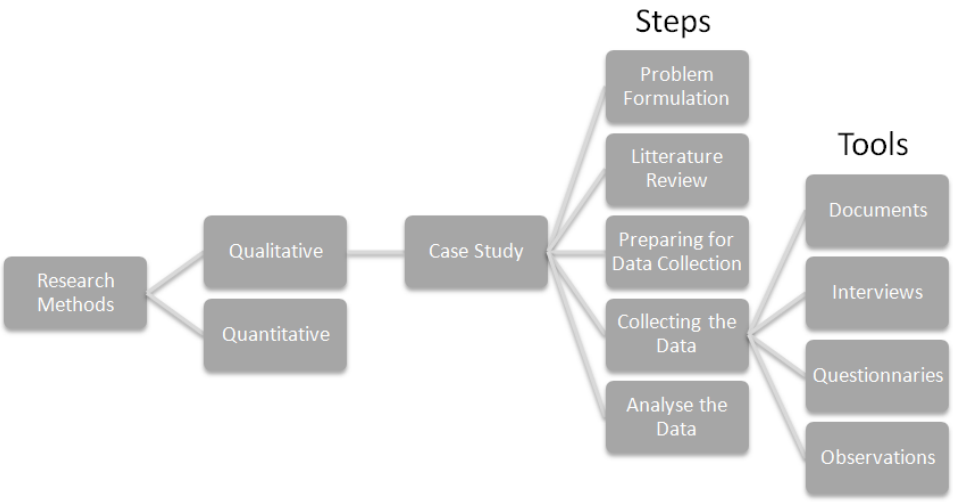

Figure 4.The case study is a qualitative research method. The structure of a case study is divided into five steps: problem formulation, literature review, preparing for data collection, collecting the data and analyse the data. When collecting the data, several tools can be used.

2.2 Case Study Process

There is no clear and defined design of a case study process. However, the process of this research was inspired by the case study process described by Yin (2002).

2.2.1 Step One - Problem Formulation

In line with the recommendations by Karlsson (2009), exploration of the topic and a brief literature review were conducted as a help to define the problem. Initial interviews were conducted in order to explore the problem area. Together with the literature review, the interviews worked as guidance when defining the problem. When the problem was defined, the authors formulated three research questions. The research questions aimed to indicate what the case study was about to examine and to point out the direction of the study (Yin, 2003). Lakshman et al. (2000) mention the importance of a clearly formulated and defined purpose for the research.

2.2.2 Step Two - Literature Review

Lakshman et al. (2000) point out that both theory and empirical data are needed to achieve a result. To get a deeper understanding of the topic that is being studied, Yin (2002) mentions the importance of theory as one part of the data collection. An extensive literature review was therefore conducted to provide the research with all necessary facts. Books, articles and doctorial dissertations were used as a basis for the theory. By using key words (Lean Product Development, Information Flow, Information Sharing, Information Quality and Managing Information) and by meetings with experts, appropriate references were found. Further, references that were used in recommended literature were reviewed.

2.2.3 Step Three - Preparing for Data Collection

Depending on the aim of the interviews that were conducted, the interviews were prepared in different ways. According to Pulliam Philips & Stawarski (2008), the skill of the interviewer and how the interviewer prepares the questions are crucial for the quality of the information. For interviews with experts, where the authors found new areas and got new input, only a few questions were prepared. The interviews with employees at OEG were also semi-structured. In order to avoid possible defensiveness from the interviewees, how-questions were asked instead of why-questions (Yin, 2003).

2.2.4 Step Four - Collecting the Data

It is important to use different methods for data collection so that the reliability of the information can be verified (Yin, 2003). Structured or open ended interviews, external observations, questionnaires, participations and interpretation of documents are example of data collection tools to use in a case study (Lakshman, et al., 2000).

Most often, researchers use a combination of different tools (Darke, et al., 1998). In this research, data was gathered from documents, interviews, a questionnaire and observations. Interviews have the advantage over questionnaires that they secure information that arises during a conversation (Pulliam Philips & Stawarski, 2008). Interviews were therefore the main empirical data collection tool used in this research. The authors were located at OEG during the time of the research, which enabled observations to be done and internal documents to be found and studied.

The authors made a literature review of different data collection tools before the empirical data was collected. Different tools are suitable for different situations and it is therefore necessary to establish which tool to use when and also how the tool should be used (Pulliam Philips & Stawarski, 2008).

Data Collection Tools in Case Study Research

Documents can be anything from letters to regulations. A document is a formal data source and is to be compared to the informal sources, such as interviews and observations (Gillham, 2000).

There are three different types of interviews: unstructured, semi-structured and structured interviews. The most common types of interviews that are used in a case study research are unstructured and semi-structured interviews (Yin, 2003). These types of interviews are most often open-ended and leaves room for discussion, which can expose important subjects that otherwise may be hidden (Brewerton & Millward, 2001). As for all interviews, it is important that a literature study is conducted before the interviews start in order for the interviewer to ask the right questions and follow-up questions (Pulliam Philips & Stawarski, 2008). The interview process that is described in Appendix I was followed.

An advantage with interviews is that they leave room for discussion, but the result from semi-structured and un-structured interviews are standardised. Hence, analysing the result may be both difficult and onerous. Questionnaires are standardised and the answers are therefore easy to compare (Lakshman, et al., 2000). A questionnaire can include five types of questions (Pulliam Philips & Stawarski, 2008):

1. *Open-ended questions* – Questions where the participant writes down the answer. No alternatives are given.
2. *Checklists* – The participant choose from a list with items and check those that best suit the situation.
3. *Two-way questions* – One question is followed by another question, depending on the answer of the first question.
4. *Multiple-choice questions* – The participant choose between different statements.
5. *Ranking scales* – The participant rank given items.

Interviews and questionnaires are based on what people say that they do. Observations on the other hand provide the research with information of what the people actually do (Lakshman, et al., 2000).

How the data was gathered and the findings from the documents, interviews, questionnaire and observations are presented in the empirical findings chapter.

2.2.5 Step Five - Analyse the Data

Further, it should be considered how the collected data are to be analysed (Qu & Dumay, 2011). There are different ways to analyse the data and it is important to have a strategy for the analysis (Yin, 2003). The data was analysed according to the proposals given by Yin (2002) and Karlsson (2009) with the strategy to answer the research questions. The analysis was a comparison of the frame of references and the empirical data.

Further, validity and reliability is important in a case study research. There are several of ways to ensure validity. One way is to use multiple sources of evidence (Karlsson, 2009). Another way is to let more than one person analyse the data, which will ensure that the assigning of the data is the same

(Lakshman, et al., 2000). To ensure validity and reliability, several sources of evidence were used: documents, interviews, questionnaires and observations.

Mapping the Information Flow

From the interviews at OEG, the work sequence in the product development process was traced. A draft of the process was mapped on a whiteboard. Also, the rework process was added to the draft. When mapping processes or flows, it is important to iterate the mapping with the sources. By iteration, verification was made and new input was added to the mapping. A suitable number of iterations would be one to two (Burns, 2007). When the draft was finished, it was first verified by comparing it with the interviews and then iterated with some of the interviewee to verify the map.

2.2.6 Step Six – Reporting

Both the work sequence flow and the information flow are shown in the Swim Lane Flow Chart. Therefore, the Swim Lane Flow Chart was the visualisation tool that was used to report the analysed flows. The draft of the processes on the whiteboard was converted and presented in a Swim Lane Flow Chart.

Further, the distances between PE and other divisions were visualised in a sea chart where the divisions were represented by islands. An A3-report was finally made to summarise the research.

3. Frame of References

The information in this chapter provides the research with adequate fact about the research area. First, Lean thinking with focus on information flows is presented. Thereafter an introduction to management of information is presented. Further, information flows in product development processes is introduced. Finally, information quality is presented.

3.1 Lean Thinking in Product Development

Womack & Jones (2003) state that Lean thinking includes value creation, value stream identification and creation of a value stream flow without interruptions. Lean thinking is a philosophy that can be used for strategic levels and for service oriented operations. There are three central core elements in Lean thinking: creating customer value, empowering employees and continuous improvements (Liker, 2004). Practically, creating customer value means delivering what the customer needs and delivering it when the customer needs it (Bergman & Klefsjö, 2010). Ishikawa (1982) defined the customer as *"The next process is your customer".* According to Womack & Jones (2003), one of the two principles in Lean thinking is to focus on the flow, or Just-in-Time (JIT). In product development processes, the flow is information and knowledge (Oppenheim, 2004).

Further, delivering what the customer needs can be equalised to quality. Toyota uses the word Jidoka for quality, which translated to English means find and fix errors (Liker, 2004). This is the second principle of Lean thinking. Thus, Jidoka refers to deliver what the customer needs, and JIT refers to deliver it when the customer needs it (Hågeryd et al., 2005). Schonberger (2006) mentions the employee involvement as one core element that will create both Jidoka and JIT. Locher (2008) means that Lean Thinking aim to create "eyes for flow" and "eyes for waste".

3.1.1 Visualising the Product Development Process and its Related Information Flow

Bergman & Klefsjö (2010) discuss the importance of knowing who your customer is, i.e. which the next process in the value adding chain is. One way to understand which the next process is, is to map and visualise the process flow. When mapping and visualising the flow, different types of process maps can be used (Bergman & Klefsjö, 2010).

To be able to improve the flow between processes, not only the flow but also existing problems need to be visualised (Graebsch, 2005). Modig & Åhlström (2011) discuss the importance of creating a holistic system with visible flows. A holistic approach has great potential to make the organisation more beneficial (Hicks, 2007). If something happens that interrupts the flow, weather it is a project process or a production process, the flow visibility is vital to be able to immediately find the problem (Liker, 2004).

A current state map can be developed by mapping the processes (Locher, 2008). However, product development processes are most often variable and it can be difficult to map them. The variability can depend on several different causes. First, variability can occur when the same resource are involved in several different projects with different work tasks. Second, variability can occur if information is waiting to be processed or if there are information quality issues that result in rework. Another important root cause for variability is if work standards and set processes are not followed (Locher, 2008). Locher (2008) also mentions insufficient planning as a root cause for process variability. Insufficient planning is especially a problem when divisions share resources.

3.1.2 Waste in Product Development

Modig & Åhlström (2011) define flow efficiency as ”The sum of value creating activities in relation to the total lead time”. Flow efficiency does not necessarily refer to shortening the lead time; it may also refer to increasing the value adding activities and to eliminate waste. In general, only 10 percent of the work within a system creates value to the customer. The rest, 90 percent, is waste (Liker, 2004). In aerospace and defence organisations, the amount of waste is between 60 and 90 percent (Oppenheim, 2004). To increase the value adding work, waste must be reduced (Hines et al., 2004). Lean Thinking has been proven to works as an antidote to waste (Womack & Jones, 2003). Kato (2005) has identified nine categories of information wastes in product development processes: overproduction, waiting, transportation, over processing, motion, rework, reinvention, hand-off, defective information.

Overproduction, also mentioned by Locher (2008), refers to an organisation that creates more information than what is needed and also that creates it sooner than needed. Waiting can be divided into three categories: people waiting for information; information waiting for people; and people waiting for capacities. The causes for waiting can be lack of information quality (Graebsch, 2005). Transportation refers to transfer of information. A typical example is the approval processes where many persons must sign papers (Locher, 2008; Kato, 2005). Over processed information is information that uses more resources than what is needed for a specific task and that is beyond what the user needs (Locher, 2008; Graebsch, 2005). Motion, especially motion of people, is a waste when people must spend time on finding persons, documents, meetings etc. (Kato, 2005). This is related to searching for information. Rework is a waste that for example can occur due to changes of requirements (Kato, 2005). Reinvention refers to redesigning the same thing or designing similar things twice (Kato, 2005). Hand-off of information must be done carefully so that important information does not get lost (Graebsch, 2005). Defective information can be connected to both overproduction and rework. This type of waste occurs when the information does not fulfil the requirements (Graebsch, 2005).

The understanding of waste in product development and in information management is a critical factor. Information management wastes can be seen as the actions needed to gather the information that is needed to perform a specific task (Hicks, 2007). Compared to Lean manufacturing, where the wastes are straightforward, the wastes in product development and information management are less clear and less visible (Hicks, 2007).

3.1.3 Standardised work

One of the core elements of Lean thinking is continuous improvements. However, before continuous improvements can be a part of the daily work, the processes must be standardised. At Toyota, standardisation is the foundation for continuous improvements, innovation and employee growth (Liker, 2004). Standardisation serves as a reference point from which improvements are made (Emiliani, 2008).

Standards should be specific enough to be useful guides, but still general enough to allow some flexibility. Some organisations use standards to control their employees and to catch them when they are breaking the rules. The result of that is a feeling of alienation among the employees and is not the right way for an organisation to involve and empower their employees (Liker, 2004). This is also

mentioned by Emiliani (2008), who means that many people misunderstand standardisation as a one, set-in-stone-way to perform a task.

The intention of standardised work is the opposite; the employees themselves should design and improve their work into one best practice method, which leads to participation, involvement and allowance to control their own work. If delivery or quality issues occur even though the standards are used, the standards should be changed and improved to prevent problems in the future (Liker, 2004). However, according to Emiliani (2008), there must be a definition of what the work is about in order to standardise it. The definition should be in correlation with the core elements and the principles of Lean thinking.

When it comes to information sharing in product development, Lee et al. (2011) suggest that the information should contain of common symbols and language together with a standardised way of transferring and sharing the information. Kim et al. (2006) point out the importance of a standardised data format to ease the use of common and concise terms. In order to achieve process simplification and continuous improvements, there should be standardised processes with defined parameters (Bailey & Francis, 2006). Further on, information in product development should come regularly, which enables different instances to work as one unit (Li & Lin, 2006). Properly shared information also enables design engineers to make correct decisions during the product development process (Kim, et al., 2006).

According to Lynn & Reilly (2000), teams within a project should establish a standardised system for how to manage information that concerns the project. The work teams should also initiate a systematic procedure of how to translate information about a problem that has occurred into knowledge (Lynn & Reilly, 2000). This enables the avoidance of repeating the problem (Liker, 2004).

3.2 Managing Information in Product Development

The information flow in product development has gone from “throwing information over the wall” to cross-functional, upstream and downstream communication between teams and specialists. Today, engineers in product development projects often sit together in an open space to simplify the communication. However, even though oral communication is important, written information and documents are needed. The information should be selective in order for employees to make good decisions and to work efficiently; the right information with the right amount should come to the right people at the right time (Morgan & Liker, 2006).

3.2.1 Managing Information in Product Development Projects

Product development processes are often complex. The complexity can emanate from many different sources, for example from the product itself or from the work that is required to develop the product (Danilovic & Browning, 2007). People, communications, tasks and resources must be organised in a way so that all project objectives are achieved. Feedback and communication through and across the organisation and divisions is a key for success in project management (Lock, 2007).

For an organisation that deals with several projects at the same time, a matrix organisation is preferable. When a matrix organisation is visualised, the line, a hierarchical organisation, is shown vertically and the projects horizontally (Rubenowitz, 2004). The projects flow through different divisions in the line organisation, see Figure 5. It is up to senior managers to decide whether it is the

project manager or the line manager who is responsible for the project within a certain division. Also, communication should be fast, smooth and without any barriers (Lock, 2007).

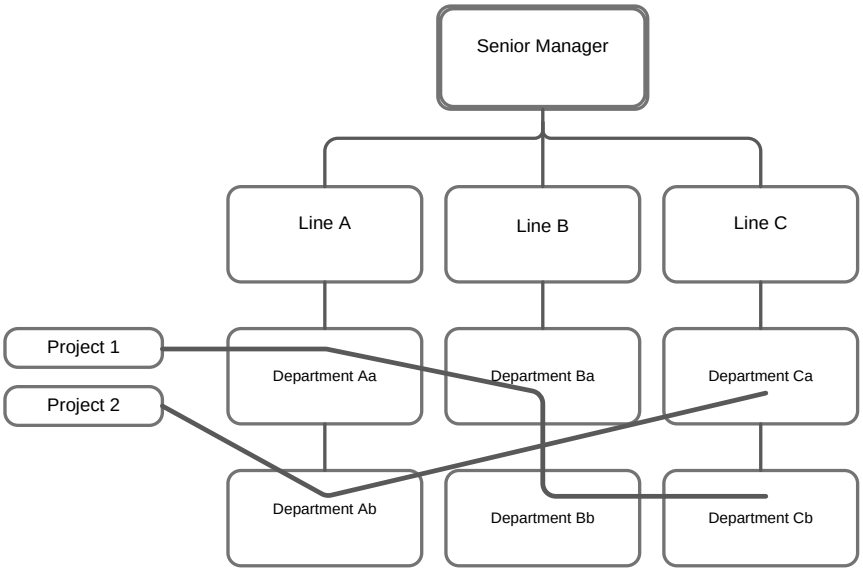

Figure 5. In a matrix organisation, projects flow through different divisions in the line organisation.

When a company develops and produces complex products, it is common to split the product into modules. Different teams are then in charge of developing a single module, which enables specialised teams to work independently from other teams (Lock, 2007). However, according to Bolton & Dewatripont (1994), the more specialised teams are, the more communication is required to coordinate them. The modules have to be adjusted and fit each other to create the whole product; thus, interactions and communication between the teams are necessary. In product development processes, the horizontal interaction is particularly critical (Hoegl, et al., 2004).

Set-Based Concurrent Engineering is a strategy described by Sobek, et al. (1999) amongst others. The strategy is that an organisation should focus on sets of solutions instead of point solutions. Point solutions are time consuming and require many interactions (Sobek, et al., 1999). Concurrent Engineering aims to approach product development by working with parallel activities. How this work is performed is up to the single engineer but it is important to start with a broad set of solutions. Over time, more details are determined and solutions can be rejected (Sobek, et al., 1999).

3.2.2 Information Types

In order to manage and map the information flow, it is necessary to understand that there exist different types of information (Graebsch, 2005). According to McManus (2005), information can be divided into three main categories; flow in the direction of the value stream, downstream flow and flow within the process.

1. Flow in the direction of the value stream – This type of information is called product information. The information should provide the user with information regarding the product that is to be developed, for example size and colour, i.e. information that describes the product (McManus, 2005).

2. Downstream flow – The flow back through the value stream can be either feedback, iterations or control information. A typical example of downstream information is rework requests (McManus, 2005).
3. Flow within the process – Within the process, the main type of information flow is information that is meant to inform someone about the process. This is called management information, and is for example schedules and organisational charts (McManus, 2005).

3.3 Information Transfer in Product Development

An information flow is equivalent to the transfer of information between divisions within an organisation, and is a critical parameter for the organisation's competitiveness. In product development, it is however not unusual that the design engineers do not find the specific information that is needed to develop a product (Powell, 2011). For a product development process to be efficient, collaboration and information transfer between divisions and design engineers is necessary (Kim, et al., 2006).

Different authors have different views on information transfer. For example, Sun & Yen (2005) refer information transfer to the distribution of useful information between different users, i.e. people, systems or organisational units. The importance of a shared vision is mentioned by Lynn & Reilly (2000) who means that a clear goal creates a domain of interests, which helps to keep the right focus when searching for or providing information.

During the product development process, a number of information gaps can occur that may lead to customer dissatisfaction. The first gap is between the customer demands and the creation of specifications of requirements. The second gap is between the specifications of requirements and the product design. The third gap is between the product design and the process design, i.e. in the process development. The fourth gap is between the process design and the final product, i.e. in the production. It is crucial to share the right information during the hand-over between the different phases in the product development process to minimise the gaps (Calabrese, 1999).

It can be difficult to separate useful information from un-useful since an information transfer usually consists of more than one piece of information (Graebsch, 2005). Sun and Yen (2005) points out that it is important to only fulfil the requirements of the information. This can be achieved by simply share information that pleasantly answers the following four questions:

1. What information should be shared?
2. Who should the information be shared with?
3. When should the information be shared?
4. How should the information be shared?

Additionally, Hågeryd et al. (2005) and Modig & Åhlström (2011) mention the importance of sharing information in the right amount. Womack & Jones (2005) further points out the importance of providing information to the right place.

The potential of an organisation to transfer information depends on the quality and the value of the information. It is essential that the information sharing is motivated (Lee, et al., 2011).

Powell (2011) means that there exist sub-cultures within organisations. These sub-cultures consist of specialists who often do not communicate across their specialities. The sub-cultures have their own

languages and beliefs, which result in communication and information sharing barriers (Powell, 2011).

Lee et al. (2011) proposes that an organisation should have a mechanism where information can be shared from the individual level to the organisational level, in order to decrease the problems with information sharing between the sub-cultures. To enable information sharing with high information quality, an appropriate IT system is necessary (Li & Lin, 2006).

3.4 Information Quality

Several of authors have found different quality dimensions and quality attributes related to information. This subchapter provides a review of the existing literature and the different authors view on information quality. Wang & Strong (1996) define information quality as information that fits the user's needs. The person who is providing the information must understand what quality means to the user of the information, in order to be able to improve the information quality. Gustavsson & Wänström (2008) have identified ten information quality dimensions in manufacturing planning and control. The dimensions are compiled from a combination of information quality, manufacturing planning and control processes, management of information systems and communication in or between organisations. The dimensions are divided into two groups; accuracy (dimension number one to five) and reliability (dimension number six to ten). The accuracy dimensions are subjective requirements, whilst the reliability dimensions are objective and connected to emotions. The dimensions defined by Gustavsson & Wänström (2008) are:

1. *Complete* – the extent to which the information is comprehensive for the task.
2. *Concise* – the extent to which the information can be used directly, without a need for rework before use, in terms of format, content or structure.
3. *Reliable* – the extent to which the information provided is accurate.
4. *Timely* – the extent to which the information is delivered in time and with the right frequency.
5. *Valid* – the extent to which the information measures what is should measure.
6. *Accessible* – the extent to which the information is easy to access when it is required.
7. *Appropriate amount* – the extent to which the information needs filtration.
8. *Credible* – the extent to which the information is accepted or regarded as true, real or believable.
9. *Relevant* – the extent to which the information is appropriate for the task and applications.
10. *Understandable* – the extent to which the information is easy to use and understand.

The first dimension, *complete*, proposes that the information must be of sufficient breadth and depth, and also meet the requirements from the user. Complete information enables the user to analyse the information and make decisions based on it (Gustavsson & Wänström, 2008). Moenaert & Souder (1996) call this dimension *actionablility*, which refers to the potential of the user to take actions based on the received information. If the information is not complete, the user must take action to find more information, which may lead to increased lead-times (Kato, 2005).

Secondly, the information format should be task oriented and *concise*, so that the user directly can use the information without any need of reworking the information (Gustavsson & Wänström, 2008). By having concise information, it is possible to avoid unwanted iterations that affect the information flow (Graebsch, 2005).

Further, the information should be trustworthy, accurate and *reliable* (Gustavsson & Wänström, 2008). The reliability dimension is also mentioned by Bergman & Klefsjö (2010), who describe eight quality dimensions for services. One of the dimensions is *reliability* which refers to doing what is promised and delivering in the right time.

The information should come in the right *time* and within correct intervals; not too often, nor too seldom (Gustavsson & Wänström, 2008). The time dimension is included in the punctual deliveries mentioned above, and is also included in Moenaert & Souder´s (1996) and Wang & Strong´s (1996) articles. The time factor is also included in Lean Thinking, and can be compared to the waste waiting, i.e. waiting for information. The time factor may affect the total lead time of the project (Locher, 2008).

The information should be *valid* with common language and measurements, so that it can be used in the right way (Gustavsson & Wänström, 2008). The validity is further mentioned by Moenaert & Souder (1996) and may also be compared to the waste defective information. When information is defected, or incorrect, it must be changed or reworked (Locher, 2008). Rework might lead to unwanted iterations (Kato, 2005).

The next dimension states that the information should be easy to *access* whenever it is required. The accessibility is also mentioned by Lynn & Reilly (2000) who points out that it should be both easy and fast to access the information. However, the importance of access security must not be neglected (Wang & Strong, 1996).

As a continuation to the *complete* dimension, the information should be of an *appropriate amount* (Gustavsson & Wänström, 2008). Too much information is difficult to overview, but it must still be enough of information in order to make decisions. The effect of sending too little information can result in iterations that may affect the product development time (Locher, 2008; Graebsch, 2005). Wang & Strong (1996) suggests that the user specifies what task that is being performed, in order for the information provider to provide the right information. Further on, deliver appropriate amount of information is about not producing more information than what is needed, which is the Lean waste overproduction (Locher, 2008).

Further, the user of the information must trust the information and see the information as a reliable reflection of the truth; the information must be *credible* (Gustavsson & Wänström, 2008). In addition, the provider of the information must been seen as credible by the user, since the relationship between the provider and the user affects the effectiveness of the information sharing (Moenaert & Souder, 1996). Also, the information should be *relevant* with the right focus for the work task. The user should be provided with the information that is needed and required, nothing else (Gustavsson & Wänström, 2008). The importance of credibility and relevance has been shown by Moenaert & Souder (1996) who found that the credibility and the relevance of the message had strong influence of how the information was seen as valuable.

Finally, it is of great importance that the information is *understandable*. The meaning of the information should be obvious for the user and have right language, symbols and units (Gustavsson & Wänström, 2008). However, Moenaert & Souder (1996) have found a moderate relationship between the comprehensibility of the information and the value aspects. Nevertheless, they declare understandability as one of the information quality dimensions and mean that the more complex the

product is, the more important comprehensibility is. Since information should be understandable, Petkova et al. (2005) mention the importance of a close collaboration with the persons that are in need of the information. The collaboration is an important factor when striving for a smooth information flow (Petkova, et al., 2005).

4. Empirical Findings

In this chapter, the collected empirical data is presented. First, relevant documents from OEG are presented. Secondly, the empirical data gathered from the interviews and the questionnaire are summarised. Finally, data from observations are presented. The observations are both observations made at OEG, study visits at other companies and form a course in Lean Product Development.

4.1 Documents

To get a deeper understanding of the problem area for this research, intra-organisational documents regarding the Lean work at OEG were studied. To get basic knowledge about the organisation, the authors studied documents posted at OEG´s intranet. Organisation charts were studied in order to get an overview of the organisational structure and divisions at OEG. Further, project maps were studied to understand how the product development processes are and how the information should flow. Also OEG's internal Wiki was studied.

4.1.1 OEG´s view on Lean

There are 11 different aspects on Lean at OEG, see Figure 6. It is mentioned in Lean documents that a number of actions should be considered when OEG strives towards becoming more Lean. First, it is important to create a culture where the employees dare to act and where problems are visualised. Secondly, it is crucial to understand the flow, i.e. to know who your internal suppliers and customers are. Finally, it is stated that the employees should avoid optimising their own work, without considering the flow and the system as a whole.

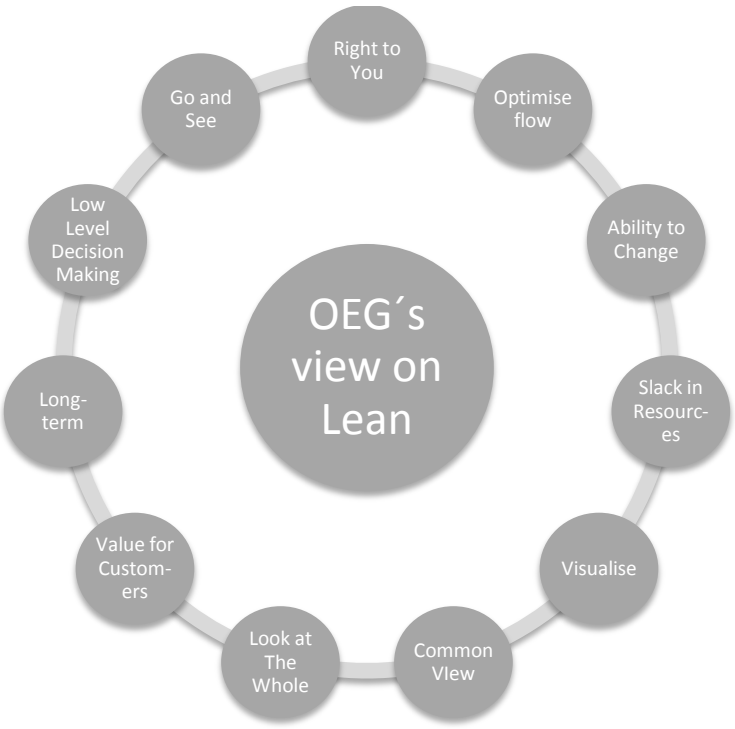

Figure 6. OEG´s view on Lean and the 11 different aspects.

It is described in the documents that the root cause to a problem must be found in order to continuously improve. Everyone should be included in the improvement work. It is also mentioned that every problem should be seen as an opportunity to improve. If an error is detected, the process should stop in order for the employees to reflect and gain knowledge. The employees should "go and see" instead of speculate and guess how to solve a problem.

4.1.2 Organisational Structure

In the line organisation, the following divisions can be found at the same level as PE: Giraffe and Arthur System Office (DG); Integrated Logistics Support and System Safety (DI); Configuration Management (DO); Subproject Management (PL); Electronics & Power (PK); C3, Training Systems & Computer Platforms (PP); Signal & Data Processing (PS); Microwave, Antennas & Laser (PU); Project Management (BR); Procurement (SI); Projects, Logistics and Test Development (SB); Manufacturing (SP).

The Matrix Organisation

To achieve a closer collaboration between the lines and the projects, OEG recently reorganised their matrix organisation, see Figure 7. In the matrix organisation, the line management, together with the project management, should create opportunities and spend less time on discussing cost or decision-making. The aim with the new organisation is to work together in the same direction. The desired benefits are less "blame allocation", less sub-optimisation regarding the economy, less demands for reports etc. The focus should be on the customer and to find the best solution for the task.

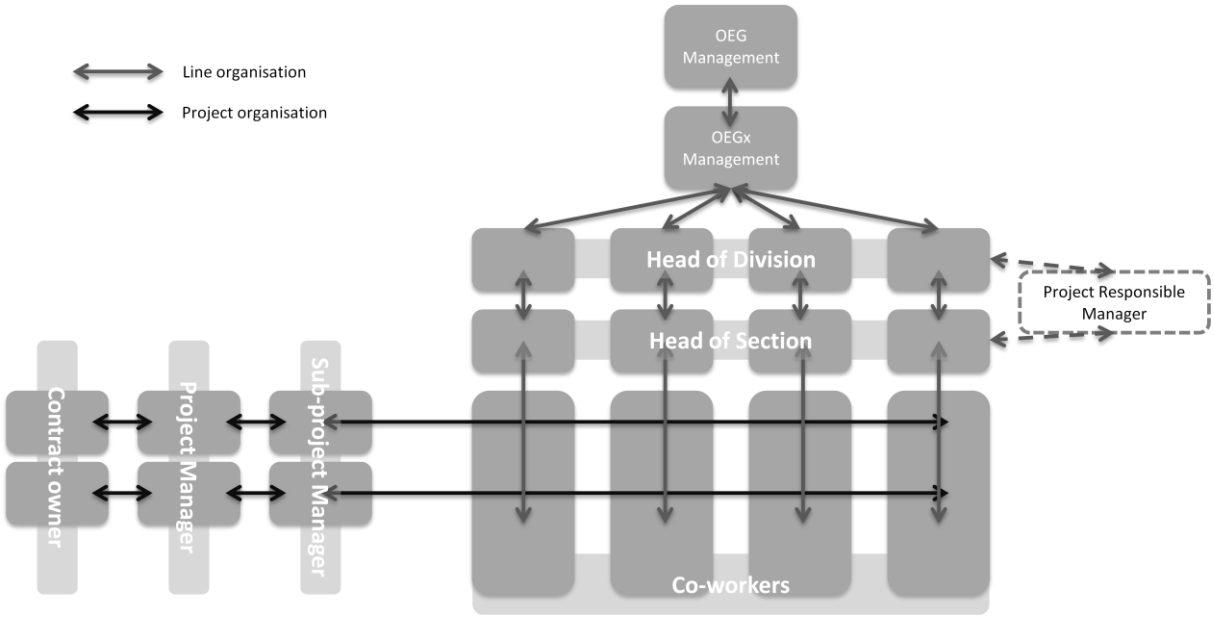

Figure 7. The new matrix organisation at OEG.

A task-specification is created by the contract owner and is sent to the project manager. The project manager is responsible for informing all concerned instances about customer requirements that affect the sub-projects or the entire project. In close collaboration with the co-workers, the sub-project managers lead the sub-projects. Further, the sub-project managers inform the project manager of how the sub-projects are proceeding. The head of division and the head of section are parts of the line management. The head of division can appoint a project responsible manager that ensures good communication between the project and the line. The co-workers are responsible for making sure that the work is in line with set processes and methods in their area of skills.

4.1.3 The Product Development Process

In Figure 8, the product development process is shown. The process is shown from PE´s point of view. The design work which PE is performing is within the Develop Subsystem and Implement Subsystem sub-processes.

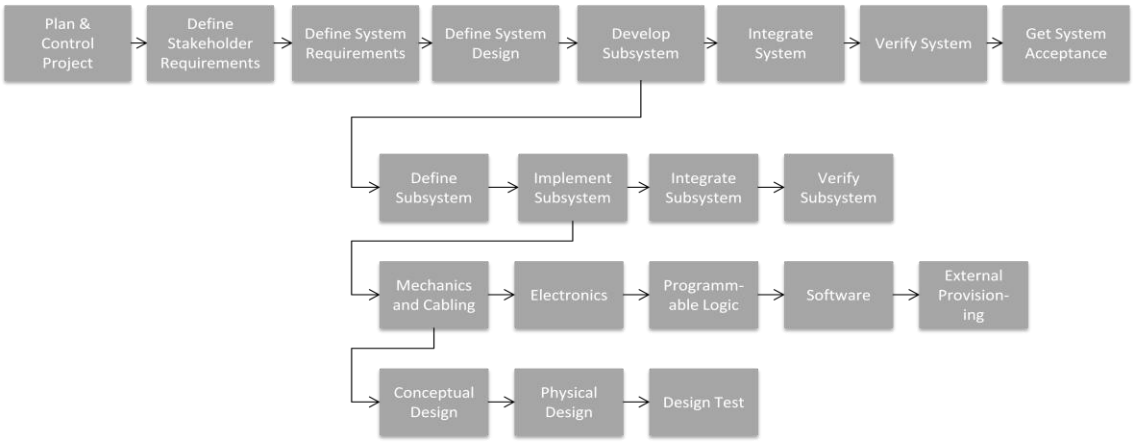

Figure 8. The product development process from PE´s point of view.

The product development process at PE starts with developing a conceptual design, followed by developing a physical design and finally testing the design.

At OEG, the processes have a process owner and a process driver. The process driver work with development of the processes. Depending on the size of the process, more employees can be involved in the process development. The process driver work fulltime with developing the processes and does not necessarily work with the task that the processes concerns.

4.1.5 Internal Wiki

At OEG´s intranet, an internal online form, which can be compared to Wikipedia, can be found. The purpose with the Wiki is to spread information about the product development at OEG, and also to spread information and knowledge within the product development. Links to documents about technical areas, abbreviations, products, components etc. can be found in the Wiki. Additionally, a list of employees with their respectively expert area and current project can be found. At the Wiki, no control documents about processes or operations are to be posted. The internal Wiki is under development.

4.2 Interviews

17 interviews at OEG and four interviews with external experts were conducted. The interviews at OEG had two intentions; first to provide the authors with basic understanding of the organisation and the information flow, and secondly to get more information about the information flow and possible barriers. Also, the interviews worked as a basis to find critical information quality dimensions. Semi-structured interviews were conducted with key persons in the base project. The key persons are persons who have a central role in the project. For these interviews, only a couple of questions were prepared in order to open up the opportunity for the interviewee to talk freely about the area that was discussed. Further, interviews with senior design engineers were conducted. The senior design engineers have great knowledge about the design work at OEG in general and at PE in particular. The interviews were semi-structured, for the same reason as for the interviews with the key persons. However, some more questions were prepared. To get the right information, the

questions were based on the frame of references. The senior design engineers were asked the same questions which enable for the authors to compare the answers. The questions are found in Appendix II.

The intention with the interviews with experts was to provide the authors with adequate knowledge about the topic of this research and to find new references, but also to get inspiration of how to improve the current situation.

A list of the interviewees that includes the title of the interviewee, at what division the interviewee work, date of the interview, how long time the interview took and the type of interview can be found in Appendix III.

4.2.1 Interviews at OEG

Interviews were conducted with divisions within the organisation that have direct or indirect information transfer and communication with PE. The interviewed divisions are: Giraffe and Arthur System Office (DG); ILS & System Safety (DI); Project Management (BR); Subproject Management (PL); Procurement (SI); Manufacturing (SP); Microwave and Antenna (PU); Electronics & Power (PK); Configuration Manager (DO). One or two employees at each division were interviewed, see list in Appendix II.

Giraffe and Arthur System Office (DG)

The interviewee at the Giraffe and Arthur System Office division (DG) works with the development of specifications of requirements. In most cases, specifications that are used for other products are re-used. In the development of the specifications, the sub-system responsible at PE is involved since the sub-system responsible has greater detail knowledge about the product compared to DG.

The time it takes to create a specification varies a lot but generally about one month is a standard time. The date set for the final delivery to customer does not change regardless of how long time the sale process takes. As a consequence, it is common that DG runs over the time and that the specifications to PE are late. Another reason for late specifications is that complex investigations also take a lot of time.

It is common that PE review the specifications from DG, and also the other way around. If the requirements are vague or not understandable, the design engineers contact DG through phone calls, meetings or mail. If the requirements are not realisable, PE calls for a meeting. When the design engineer detects defects in the specifications of requirements, he or she either talks directly to DG or sends an EEH.

Changes in the specification can be due to changes of customer requirements. At times, the specification changes are communicated verbally and informally.

ILS & System Safety (DI)

ILS and System Safety (DI) works with customer documentation, customer education, calculations and analyses of how often products need to be maintained and the need for spare parts. Information from PE is needed to create the component specifications and system specifications to the customers. The information that is needed can be found in documents. However, it is too complicated to go through the documents. Instead, DI asks PE which documents that are needed and

where in the documents the information can be found. Further, DI has meetings or interviews with a design engineer at PE regarding the finished product to get the information that is needed.

During the development of the customer documentation, the documents are iterated between PE and DI, sometimes up to five times. However, it is most common that there are one or two iterations.

Since PE does not automatically report to DI, DI must ask for the information needed and also for changes made on the mechanical system. DI experiences that it is sometimes difficult to receive all the required information. It is said that DI shall have a contact person at PE and the other way around, but this is not always the case. According to DI, a sub-product responsible should be the link between PE and DI. In many cases, the employees at DI contact someone within his or her personal network. How the information is shared depends on the employee and the personal network. An employee that has been working at Saab a long time has an extensive personal network, and contacts someone he or she knows or thinks can help. For a newly employed employee, it can be difficult to find the right person. However, the opinion at DI is that there is a customer focus that has a positive effect on the communication.

When DI sends an EEH that affect the mechanical design, the EEH is handled by a design engineer. The design engineer writes the status of the work into the EEH. It is common that the design engineer at PE does not understand the EEH and that more information is needed. After the changes are made, the design engineer asks for feedback on the changes from DI.

Project Management (BR)

At the Project Management (BR), the work tasks are to have customer contact, have the project responsibility and to put together a project team (sub-project managers, system responsible, configurations manager and system verifier). If there are complaints on the product after the delivery, this is communicated through BR.

BR experience that the products are sold before the products exist and that the products are set together by sub-systems that are not compatible. The result is extra work and longer leads times.

At Clear-case EEH meetings, the project manager, sub-project managers, system responsible and technical experienced employees are gathered to discuss errors and changes that must be made on the product.

Sub-project Management (PL)

The sub-project managers were earlier parts of specific divisions, for example PE. Now, Sub-project Management (PL) is its own division. The sub-project manager that was part of PE is still located in the same open space as the employees at PE. He or she provides the design engineers with relevant specifications and information regarding the project. The sub-project manager should also be the contact person between PE and other divisions. Problems that occur at one specific division, and that affect other divisions, should be communicated through the sub-project managers. It is further the sub-project manager's (at PE) responsibility to divide EEH's to the concerned design engineer. Information regarding changes on the design can be received at sub-project management meetings.

Procurement (SI)

It is the Procurement division's (SI) responsibility to choose supplier and to order products. If there are any problems with the suppliers that are related to PE, SI discusses that with PE. There is a close collaboration between the design responsible for a specific product at PE and the purchaser at SI.

PE uploads the product designs in IFS, and most of the information that SI needs can be found in IFS. If changes must be made on the product or if there is anything unclear in IFS, SI either have a meeting with PE or create an EEH. An example is if suppliers cannot handle a certain CAD format. If so, the design engineers have to change the format in order for SI to order the product. When a change is made, PE should send a notice to SI, if not, SI notices PE to send it. Before SI can order the new products, PE must update the status in IFS. If there are uncertainties regarding if changes have to be made, SI either calls all concerned instances for a meeting or create an EEH. How this is done depends on the purchaser's experience. It can be difficult for newly employed purchasers to know how to do.

Manufacturing (SP)

At the Manufacturing division (SP), the main work task is to assemble, manufacture and test the systems. One opinion at SP is that there is a "we and them" relation between PE and SP. A number of employees at SP experience that PE does not understand why some work has to be done fast. SP have to tell PE "this has to be done, otherwise the production will stop". From SP's point of view, the feeling is that the design engineers at PE seldom visit the production and therefore do not understand the system as a whole. When test accommodations are to be set up, the production specifications are seldom finished. SP therefore have to ask PE for the required information.

PE experience that instead of finding out the answers to some questions SP asks PE for the answer. The feeling at PE is that SP asks the questions since it is less complicated and takes less time than finding out the answer by themselves. It also happens that SP comes to PE without knowing what the actual problem is. The root cause does not have to be at PE; it may be at the supplier.

Another opinion at PE is that it is beneficial to have the production in the same building since that enables the design engineers to go and see the production and to get a holistic view of the system. A number of employees at PE mention that they go to the production and look at the system when something is wrong with the design.

If an error occurs in the production, the person who discovered the error either creates an EEH or speaks to the person responsible for the design, depending on the personal network of the single employee. It is common that SP creates many EEHs. Some of the employees mentioned that EEHs from SP are not complete and that PE must ask SP what they mean. Another opinion is that all errors that occur in the production result in EEHs. However, when errors are found in the production, a fault report should be created. The fault report should then be reviewed and an EEH may be created.

An opinion amongst the design engineers is that the assemblers have a lot of opinions about the design. A comment from one design engineers was that "it is good that the designers can terminate EEHs". Therefore, EEHs are not always handled, with confusion at SP about whether the EEH has been handled or not as a result.

Microwave and Antenna (PU)

At the Microwave and Antenna division (PU), the communication with PE is mostly by mail. The information that is shared between the two divisions is most of the time information about changes or updates on existing products. If PU owns a product, they must approve changes that are being made by PE. The changes can be on either the product or on related documents.

Electronics & Power (PK)

At the Electronics and Power division (PK), electronics and power devices and parts are designed. The opinion amongst the employees at PE and PK is that the communication between the two divisions is good. During the development stage, there often is a compromise between the design from PE and PK. Due to good communication it is easy to find a good balance in the design work between the two divisions. Since there are no requirements on how the final product should look, communication between PE and PK is necessary. If the external customers do not exactly know what they want, PE and PK must work in close collaboration. PE and PK used to be the same division, which has a positive effect on the collaboration.

Configuration Manager (DO)

It is the Configuration Management division´s (DO) responsibility to make sure that all the concerned divisions get information about changes that are made. When a decision regarding changes on the product has been taken, DO contacts and informs PE about the decision. If DO needs to know what changes that already been made, PE are asked to provide that information. All changes are communicated via the CCB-meeting.

It is important that PE creates and sends PRIs so that DO receives information about changes. If PRIs are not created and sent, it will not be possible for DO to inform SP about the changes. The result is that no changes are made on the product.

At DO, some of the employees experience that the information in the PRIs can be difficult to understand. The PRIs are often on a high technical level. When the receiver of the PRI does not understand the PRI, the questions are discussed with the creator of the PRI.

General

It has been mentioned by several of employees that the set processes are generally not followed.

An EEH is a change request document that consists of information regarding problems with products or documents. When an error is discovered, there is no clear boundary between when the error should be communicated via an EEH or via a meeting with the design engineer. How the discoverer of an error does depends on the personal network and the experience. Some design engineers mean that an EEH always should be sent while others mean that it is preferable with a phone call or an email. A number of employees mean that if an EEH is not created, the information might fall through the cracks. Another opinion is that the EEH process is complicated. The EEH process differs from case to case, and the EEH can either be sent directly to the design engineer, to the sub-project manager or it can be discussed in a meeting. If the discoverer of an error does not know who to contact, he or she might solve the problem practically

PRIs are documents that handle changes on the product. A PRI should always be created when changes on the product are made and should include the new product revision, why the changes were made, how the changes were made, how the changes should proceed and what interventions

that are required. Since there is no automatic system that informs the receiver of the PRI, a PRI that is created must be manually sent to the receiver. There are templates for how a PRI should be written.

In IFS, all the product information is stored. Many employees experience that there is a lot of information in IFS and that the information sometimes gets lost. Some employees think that IFS can be confusing, for example when a complex system and a screw are stored at the same level. It can be difficult for new employees and employees that do not often work in IFS to find what they need. A number of employees think that it would be beneficial to have a search engine in IFS.

It happens that the marketing division combine different systems that are not adapted to each other and that the sales process takes long time. The employees at PE experience that the information that is needed to start working is late and that the design engineers must start working before the specifications of requirements are set. The employees mention that this is possible due to good communication and due to that the design engineers guess what should be included in the design. If it turns out that the design differs from the requirements, changes are made.

A large amount of the information that is being shared at OEG is transferred through informal communication channels, such as emails, personal interactions, phone calls or meetings. There exists no formal forum where information can be shared.

4.2.2 Interviews with External Experts

This chapter provides a summary of the interviews with external experts. A full review of the interviewee title, jobs, type of interview and date of interview are listed in Appendix II.

Interview about Lean Thinking and Information Quality

Expert 1 is a senior university lecturer and researcher at Chalmers University of Technology. He has participated in the compilation of a paper dealing with information quality (Gustavsson & Wänström, 2008). According to Expert 1, all of the ten information quality dimensions that were found are equally important. The strength with information quality is that it considers many dimensions, which may help when information flow barriers are to be found. Expert 1 mentioned that only the most critical dimensions should be evaluated.

There are different methods that can be used to map a flow, for example VSM and cross functional flowcharts. Even though the maps do not look the same, they are based on the same principles.

According to Expert 1, a matrix organisation enables the information flow by providing a clear flow direction. However, Expert 1 has a feeling of that the line organisation easily gets stronger than the project organisation.

Further on, Expert 1 talks about Lean and means that in the centre of Lean are the core values (respect for individuals and continuous improvements). The two principles Just-In-Time and Jidoka contribute to the core values and create flows and quality. Hence, the concepts of Lean and Quality are closely related. In literature a number of authors discuss 14 Lean principles. According to Expert 1, it is difficult to fulfil 14 principles. Instead the companies should focus on the core values in Lean and on what the company want to achieve.

Interview about Mapping and Improvements

Expert 2 is a PhD student at Chalmers University of Technology. His research area is Lean product development in general, and Visual Planning in particular.

According to Expert 2, VSM can be used for mapping information flows. Expert 2 advocates a VSM-exercise, where the participants trace up their own processes. Thereafter, the processes are put together into a bigger picture and may be discussed by the participants. The advantage with the VSM-exercise is that the map shows how the processes really are, not how they should be. Expert 2 also point of that focusing on a small part of a flow enables a more specific map, while focusing on a bigger flow result in a more general map.

Further on, Expert 2 means that improvements should be measured to the outmost, if it is possible. Improvements must not only be measured in QDE-terms (Quality, Delivery, Economy) since it may be difficult to deduce a certain KPI with a specific improvement. Improvements can also be measured in "soft factors", e.g. emotions.

Interview about Lean Product Development and Information Flows

Expert 3 is a professor at Montana State University with a PhD in industrial and operations engineering. At the time of this research, Expert 3 is a Visiting Professor at the Department of Product and Production Engineering at Chalmers University of Technology.

Expert 3 points out that there are two types of information flows: control information and product information. Control information deals with coordination of the work and product information deals for example with product specifications and CAD-paintings. Different tools are differently suitable for the two information types. As an example, visual planning treats control information.

It is important to first find the root cause to a problem, before finding a solution and an appropriate tool which may solve the problem. It is important to know why you are implementing a tool and what you want to achieve.

There are two types of process maps; one which shows historical cases, and one that shows general processes. However, Expert 3 means that it is important not to use the company´s documents about the processes. Rather, ask the persons who actually performs the work how they work.

In the case of information flow in product development, Expert 3 recommend the Swim Lane Flow Chart. The Swim Lane Flow Chart shows the actual case and both of the information flows in a visible way. When a process is mapped, it is often very complex. The question a researcher then should ask is: What things contribute to the mess? In Expert 3's research, the answers have been that the design engineers are iterating one-point-solutions to a problem, are providing wrong information, or that the design space is too small. An appropriate solution to a too small design space is to use checklists. To find the root cause of providing wrong information, the information quality must be considered.

Interview about Lean Product Development

Expert 4 is a PhD student at Chalmers University of Technology. Expert four's research area is Lean Product Development and how that affects product development efficiency and effectiveness.

In Lean Product Development, knowledge transfer is particularly important. Knowledge may for example be how a certain problem can be solved, see Figure 9. The knowledge is in the example transferred into a standard approach of problem solving.

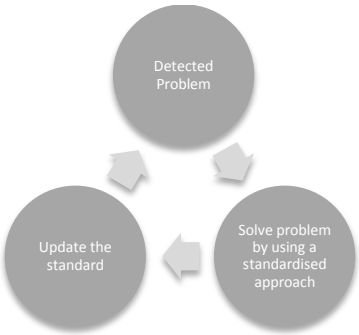

Figure 9. Knowledge may be how a certain problem can be solved. Knowledge is transferred into a standard approach of problem solving.

Expert 4 also points out that projects often are measured in QDE-terms and means that there also should be measurements of how knowledge is transferred. The Wikipedia-versions that some companies use to transfer knowledge seems to work. Expert 4 agrees with Expert 2 that a VSM-exercise may be powerful to have and that it can lead to useful discussion. Further on, a meeting where all relevant design engineers are gathered may be valuable. On the meeting, the design engineers discuss how the work is proceeding and problems are emphasized. Perhaps someone on the meeting has experienced and solved the same type of problem before and can hence share that knowledge.

It is important to analyse the problem and thereafter find tools and methods that solves the problem. Solutions, methods and tools should not only be copied; they must fit the actual problem, see Figure 10. It is important to understand what the problem is before finding solutions for it.

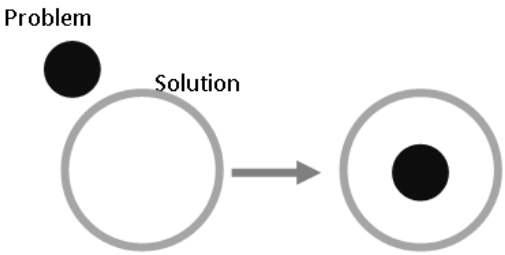

Figure 10. A good solution is a solution that captures the actual problem.

Expert 4 mentions front-loading as an important aspect in Lean product development. Front-loading refers to developing a robust design early in the product development phase, which will result in less rework later on in the process.

4.3 Questionnaire

A questionnaire was sent out to the design engineers at PE. The questionnaire consisted of a number of questions regarding the most critical information quality dimensions that had been identified from the interviews at OEG and from the literature review. The purpose of the questionnaire was to obtain comparable information, to get quantitative input to the research, and also to get information from more sources. The questionnaire is found in Appendix IV.

The number of respondents to the questionnaire was 61 persons. The focus of the questionnaire is information quality, since information quality contributes to barriers between the information provider and the receiver. Also, the questionnaire consists of questions regarding how long time the respondents have been working at OEG, how often the respondents receives information from the respective divisions, how well different information sharing channels provide information, and who the internal customers are. The information quality dimensions that were found during the interviews were further investigated by using the questionnaire. Complete, concise, timely, appropriate amount and understandable were the information quality dimensions that were mentioned as critical by most of the interviewees.

The distribution for how long time the respondents have been working at OEG is shown in Figure 11.

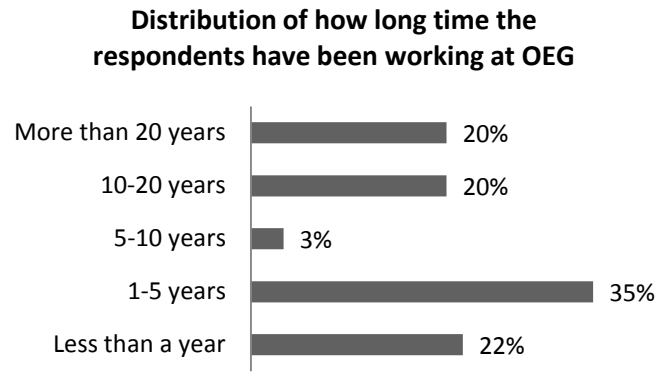

Figure 11. Distribution of how long time the respondents have been working at OEG.

In Figure 12, it is shown in percentage how many of the respondents that receive information from the other divisions.

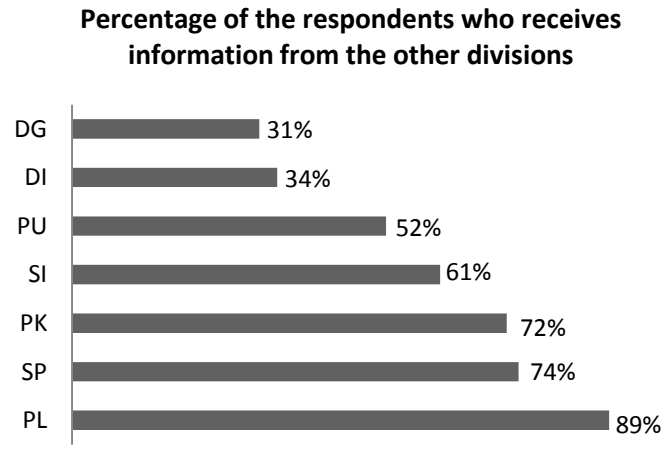

Figure 12. Percentage of the respondents that receive information from the other divisions.

Regarding the information quality dimensions, the answers to the questionnaire with clear majority is being considered. The answers show that the information that PE receives is complete most of the time. The information is also concise and understandable most of the time. However, the answers show that the information sometimes contains too little information. Also, the answers show that

the information seldom contains too much information. The information is sometimes received too late, but almost never too early.

A full review of the answers to the questionnaire can be found in Appendix V.

4.4 Observations

Observations were made at OEG in form of a recorded video, studies of visual planning boards and also by participation in a meeting. Further, observations in form of study visits at RUAG Space AB and Ericsson AB were made to get their view and perspective on how to share information. Also, the authors participated in a Lean Product Development course. This sub-chapter presents a review of the observations.

4.4.1 Observations at OEG

Every employee at OEG has to watch a set of recorded lectures that Niclas Modig, a PhD from Stockholm School of Economics, had at OEG. The purpose with the films is to spread the Lean concept among the employees. For the authors to use the same words and terms as the employees when talking about Lean, the films have been watched by the authors. The films also provided the authors with background information about why this research is important for OEG, namely the concept of efficient island within an inefficient ocean. Today, OEG is resource efficient where the different divisions, or islands, are efficient within themselves. However, the flow efficiency between the divisions needs to be improved, hence, OEG is an inefficient ocean. This is shown in Figure 13, where OEG is in the upper left corner. The expectation is that this research will help OEG towards becoming more flow efficient.

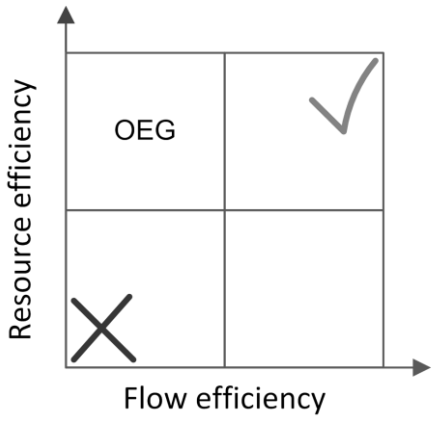

Figure 13. OEG is resource efficient and need to move to the upper right corner in order to get both flow and resource efficient, i.e. to become an organisation with efficient island within an efficient ocean.

OEG has applied Toyota´s principles about visual planning boards. At OEG, the visual planning boards are used to communicate how projects are performing and what resources that is needed or occupied. Hence, it is control information that is transferred through these boards. The sub-project managers and the line managers, who are the ones that use the boards, think that the boards are functional and that they fulfil the purpose of creating a visual overview of how projects are performing and how resources are distributed over the projects.

The authors have participated in one meeting where all the sub-project managers discussed how their project was performing by using visual planning boards. If a project had problems with delivery times or lacked recourses, the sub-project manager could announce that on the meeting.

4.4.2 Study Visits

The first study visit was at RUAG Space AB in Göteborg, which was of interest due to their close collaboration with OEG regarding the Lean work. The second study visit was at Ericsson AB in Borås. Ericsson AB was of interest since they are one of the companies in Sweden who have succeeded with the Lean work.

RUAG Space AB

RUAG Space AB in Sweden is a company with a total of 378 employees where 314 work at the head-quarter in Göteborg. Their main focus is on highly reliable on-board satellite equipment.

RUAG Space AB has experienced a phenomenon of a football field where every player stands inside a tent. When the players get the ball, they kick it out without seeing the entire plan or the other players. To handle this problem, meetings are held where information is handed over. For the hand over documents, standardised checklists are available. The checklists contain information regarding what the hand over documents should include.

There are two things that influence the communication: the organisation and how the employees are located. The employees at RUAG Space AB are located in the same way as they are organised. But according to the interviewee, the communication would have been improved if they instead are located as they work.

The interviewee's opinion is that RUAG Space AB follows their processes. The employees develop the processes themselves and it is the line management that has the responsibility for the improvement of the processes. ISO 9000 is used and has been modified a couple of times to better suit the organisation. Nowadays, RUAG Space AB uses the standard as a tool to help them develop their organisation after what the organisation believe they can achieve. The processes are revised two times per year.

At RUAG space AB they realised the importance of having a system where deviations are discovered early in the development phase. Incoming errands must be handled as soon as possible, even if it is not an urgent errand. By doing this it is possible to avoid getting a long list of errands. Unplanned errands are a disturbance in the daily work, and there is no standardised method to plan for unplanned work. The result of unplanned work is that if one employee is late, another employee will most likely be affected. In the end, the production must work at a very high speed.

RUAG Space AB has mapped the value stream of specific requirement and how the requirement was sent within the organisation. The result was a very complex flow with a high potential of being simplified. They also have a Wikipedia-version which contains "good to have-information". Links to component information, manuals and documents are examples of information that is "good to have". No control information should exist at the Wikipedia. The interviewee mentioned that knowledge building is critical for the survival of the company. It is therefore necessary to learn from past projects. In the Wikipedia, this information can be saved and easily accessed.

When errors are discovered in the production, the customer must be informed. Together with the customer, RUAG space AB decides what the error depends on and take action based on that.

When employees at RUAG Space AB send out a meeting request they first have to fill in a standardised meeting form. This form includes the agenda for the meeting and what the aim with the meeting is. The benefits with the form are shorter meeting times and that people can choose if they need to attend the meeting or not. Another benefit is that the person calling for the meeting is better prepared since he or she must think one additional time regarding if the meeting is needed and what the aim with the meeting is. There are positive reactions to the form amongst the employees at RUAG Space AB.

Ericsson AB

Ericsson AB is a Swedish company with 108,551 (Apr 25, 2012) employees around the world. Of the 108,551 employees, 1700 are located at the supply site in Borås, Sweden. The products that are produced at the Borås site are telecommunications equipment. This chapter is connected to the site in Borås and how Ericsson works at this specific site.

When a problem is detected in the production, the operator contacts the line support. The line support first tries to solve the problem at place. If the problem cannot be solved immediately by the line support, they report the defect in Clear Quest (CQ). CQ is a standardized online form that is divided into different parts. Each part represents different product groups and there is also one part for material deviations. Thereafter, the case is analysed by Quality Management (QM) who determine the severity of the problem. QM is the quality department located at Borås site but provides support globally together with Production Product Manager (PPM). The severity of the errand depends on the customer; if the problem directly affects the customer, the problem has the highest priority. If the problem is detected at another site, the errand is handled by PPM instead of QM. Thereafter, the errand is handled at the Master FRAG (Failure Rate Analysis Group), which is a meeting where all concerned technical experts is present. Here, it is determined what division that should solve the problem, for example by the product development. The process is shown in Figure 14.

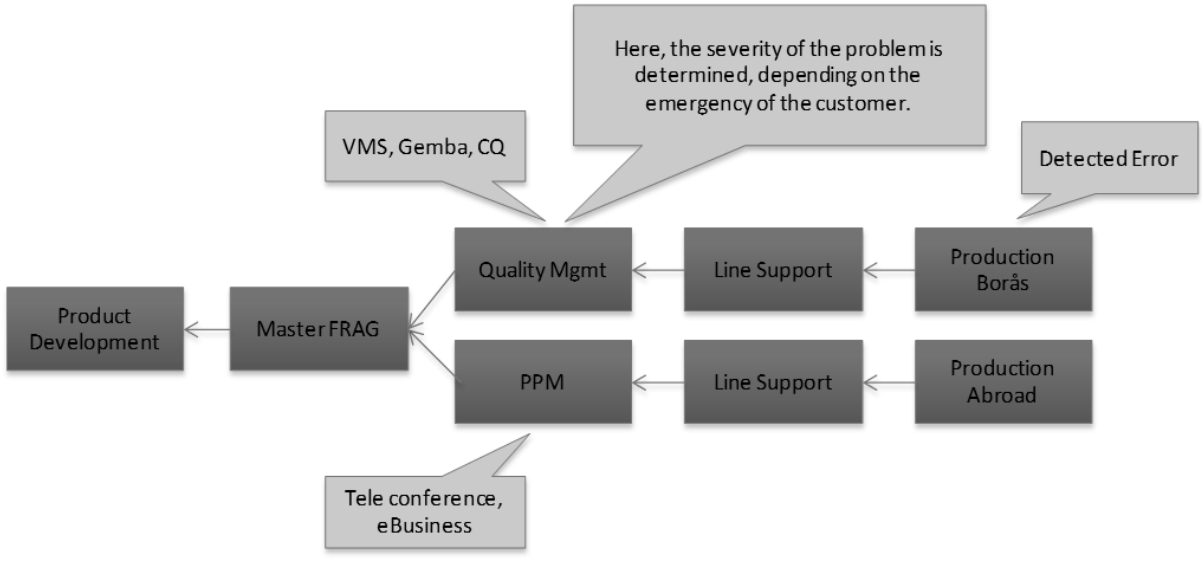

Figure 14. The rework process at Ericsson´s site in Borås.

At Ericsson, it is very strict that this process is followed. Earlier, many of the errors that were detected were communicated through several different information channels, for example mail, post-its and meetings in the corridors. This resulted in that errors was forgotten and in some cases not handled. Now, the errands that come to QM without being registered in CQ are sent back to the sender with a request of creating an errand in CQ. This has resulted in shorter handling time and reduced lead times. Earlier, it was difficult for the operator in production to know who to contact when an error was detected. Further, the operator never knew weather the errand was handled or not. Now, the operator knows that he or she should contact the line support. The operator knows that the error will be taken care of.

If the error that comes in to CQ affects other sites apart from the Borås site, the errand is converted into a format that is suitable for E-business. E-business is an online-form and a collaboration area where errors from the different sites around the world are documented. It is the FRAG-leaders within QM or PPM responsibility to determine if the problem may affect other products as well.

In the morning, the FRAG-leaders visit the VMS (Visual Management System) meetings where information concerning the errands is shared verbally. The same information can also be found in CQ. However, the FRAG-leaders do not receive an automatic message when an errand is created in CQ. Thus, the FRAG-leaders need to check CQ every morning to find the incoming errands.

For information that is not related to product errors, there is a possibility to send an email to a mailbox owned by the quality department. One example is if it is possible to re-use a specific part when a mail is sent from Ericsson Return Logistics (ERL) to the common mailbox. This information should not be added to the CQ.

In CQ, solutions to old problems are documented and can be found. However, the search engine in CQ does not work properly; the search engine demands that everything is written in the exact same way.

At Ericsson, they also have a yield warning system that measures how well the manufacturing is performing from a quality perspective. Further, small deviations and changes on a product are caught up in this system. They also have a tool that measures the cost of poor quality and shows the products that are most costly due to poor quality.

4.4.3 Lean Product Development Course

In March, 2012, the authors participated in a two plus one day course in Lean Product Development given by Swerea IVF. The outline of the course was to introduce Lean Product Development and how it might improve an organisation by creating a learning organisation, efficient management, better products, faster time to market and higher profitability. From the Lean Product Development course some interesting information was found.

A known principle in Lean Production is “go and see”, which can be applied in Lean Product Development. The design engineer should go and see when the product or the prototype is being built and the design engineer should also converse with the assembler. It is important that the design engineer participates during the tests of the product that has been developed. Respect for people, also a principle from Lean Production, is very important in Lean Product Development. The employees should both feel that they are a part of the system and also be a part of the system. The

individuals are influenced by the culture, the collective knowledge, imagination and by the set rules. Since there are often barriers between divisions and people, it is important to work with improving the communication between them.

In traditional product development, the focus of a project is to optimise and iterate until the specifications of requirements are fulfilled. The most important decisions regarding the concepts and architecture are made when the knowledge is at its minimum. The product often needs to be further developed after it has been sent to production. The result of this is poor quality that in turn results in change orders, which will lock up resources that could have been used in upcoming project.

Set-based design is another way of working with product development. Instead of choosing the product design in the beginning of the project, it should be set as late as possible, but not later. The knowledge about the product will grow over time. There are many benefits of having a set of solutions instead of one, for example lower production costs and reduced need for unnecessary communication.

5. Analysis

This chapter provides an analysis of the collected data. The aim with the analysis is to answer to the research questions. First, an analysis of the information flow is made in order to answer research question one (RQ 1). Secondly, the most significant barriers between PE are identified. This answers the second research question (RQ 2). Finally, with RQ 2 as a basis, it is suggested how the barriers can be reduced to improve the information flow. This answers the third research question (RQ 3).

Out of OEG´s 11 aspects on Lean, some aspects are closer connected to this research. In Figure 15, the aspects that are primarily for this research and how they are connected are shown. The arrows represent the connection between the aspects.

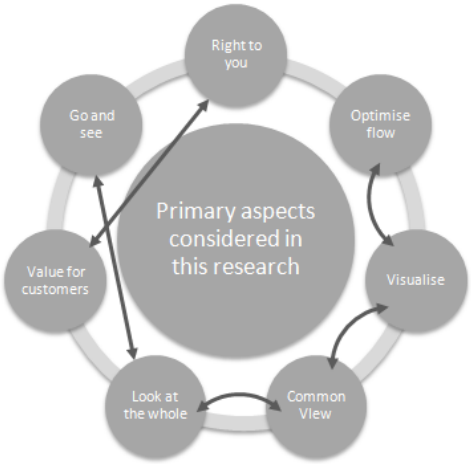

Figure 15. The Lean aspects that are considered in this research.

5.1 Information Flow between PE and the Other Divisions at OEG

Due to the complexity of the products that are developed, cooperation and communication between different divisions are necessary. At OEG, the employees are located in open spaces, which, according to the theory, simplify the communication. OEG manages a number of different projects at the same time. When working with complex products and several projects it is beneficial to be organised in a matrix, as OEG is. OEG recently re-organised the matrix organisation and is still working on developing the structure. The benefit of a matrix organisation is that it gives a closer collaboration between the lines and the projects. As mentioned by Expert 1, a matrix organisation will improve the information flow, but there is still a risk that the line organisation gets stronger than the project organisation.

5.1.1 Information Sharing between PE and the Other Divisions at OEG

This sub-chapter provides an analysis of the links between PE and the other divisions at OEG. The links describe how PE shares information with the other divisions. Also, this sub-chapter includes an analysis of what information type that is being shared, and in what frequency the information is shared. The main OEG Lean aspect that is concerned in this sub-chapter is V*isualise*.

Information Sharing between PE and DG

There are several of different information sharing channels that are used between PE and DG. Most information is shared in meetings (89 percent) or by email (79 percent). About 50 percent of the respondents to the questionnaire that have contact with DG receive information by telephone, by the sub-project manager at their division, through personal interactions or by spontaneous meetings in the corridors.

Most of the information that PE receive from DG concerns specifications of requirement and new designs. The information can also be about EEH-errands and re-designs. A number of the design engineers mention that they also receive information regarding layouts, interfaces in the projects, interfaces between the organisation, and authentication errands. PE provides DG with expertise regarding the mechanical design to the requirement specifications.

Only two percent of the respondents receive information from DG on a daily basis. Most common is that the respondents receive information on a monthly basis (17 percent). Seven percent of the respondents receive information on a yearly a weekly basis.

A summary of the links between PE and DG, the information type and the frequency is found in Table 1.

Table 1. A summary of the most commonly used links, the information type and the frequency of the information sharing.

Links	Information Type	Frequency
Meetings & email	Product information	Monthly & yearly/weekly

Information Sharing between PE and DI

81 percent of the respondents receive information from DI via email. 71 percent receive information via meetings and 52 percent via phone calls. 38 percent receive information by go to DI and talk, or when DI come and talk at PE. 33 percent receive information via the sub-project manager, and 24 percent receive information during spontaneous meetings in the corridors. One respondent to the questionnaire mean that the required information is received through the technical responsible at PE. Another respondent mention that information is shared between PE and DI during work-meetings where two persons sit and work together.

The information that is shared between PE and DI differs a lot. 52 percent of the respondents answered that the information deals with other areas than EEH-errands, simple re-designs, specifications of requirements or design specifications. Rather, the information deals with spare parts, documents and manuals. 43 percent of the information deals with EEH-errands, and 29 percent deals with simple re-designs and specifications of requirements, respectively. 19 percent of the received information is about design specifications. Most of the information that DI requires from PE is information that is needed in order to create manuals. The information that PE provide DI with is feedback and verification of different documents and manuals.

No one of the respondents receives information from DI on a daily basis. Most of the respondents (17 percent) receive information a couple of times per month, 12 percent receive information a couple of times per year, and 5 percent receive information a couple of times per week.

A summary of the links between PE and DI, the information type and the frequency is found in Table 2.

Table 2. A summary of the most commonly used links, the information type and the frequency of the information sharing.

Links	Information Type	Frequency
Meetings & email	Product information	Monthly & yearly

Information Sharing between PE and BR

The design engineers at PE do not have direct contact with the project managers at BR. Information is rather shared through PL.

Information Sharing between PE and PL

The sub-project manager is part of PL, but is located close to the design engineers at PE. PL´s function is to work as a contact person between PE and other divisions. 89 percent of the respondents to the questionnaire receive information from PL. Most of the information is shared in meetings (91 percent) or by email (87 percent). 69 percent receive information by phone calls or when they spontaneous meet in the corridor.

Most information regards new design (74 percent) and re-designs (72 percent). Apart from this, the design engineers receive information from the sub-project manager that concerns specifications of requirements (48 percent), construction requirements (54 percent) and EEH-errands (46 percent). Some information also concerns basic data for developing specifications for new external products, general project information, reparations, failures and test specifications.

48 percent of the employees at PE receive information from PL a couple of times every week. 30 percent receive information monthly, and 15 percent daily.

A summary of the links between PE and PL, the information types and the frequency is found in Table 3.

Table 3. A summary of the most commonly used links, the information types and the frequency of the information sharing.

Links	Information Types	Frequency
Meetings & email	Product information & downstream information	Weekly & monthly

Information Sharing between PE and SI

There is a close collaboration between the design engineer for a specific product at PE and the purchaser at SI. Email is the most frequently used information sharing tool, as much as 97 percent of the design engineers at PE receive information from SI by email. 73 percent of the design engineers at PE receive information by phone and 59 percent receives information from SP during meetings. It is also common that PE receives information in person (57 percent) when SI comes and talk to PE, or the other way around. 22 percent receive information from PL and 27 percent receive information during spontaneous meetings in the corridors.

Most of the information that is received from SI regards new design (61 percent). 44 percent of the respondents receive information that concerns simple re-designs and 17 percent of the respondents receive EEH-errands. SI needs specifications from PE in order to purchase products. If the specifications are not correct, SI contacts PE. Also, if there are problems with the manufacturing basic data from the supplier, SI contact PE. Questions from the supplier are also communicated from SI to PE. For failures on the purchased product, SI contact PE.

12 percent of the respondents receive information from SI on a weekly basis, 40 percent receive information monthly and eight percent receive information from SI a couple of times every year.

A summary of the links between PE and SI, the information type and the frequency is found in Table 4.

Table 4. A summary of the most commonly used links, the information type and the frequency of the information sharing.

Links	Information Type	Frequency
Email & phone calls	Product information	Monthly & weekly

Information Sharing between PE and SP

Email and phone calls are the most frequently used tools for SP to share information. 89 percent of the respondents receive information from SP by email and 87 percent of the respondents receive information from SP by phone. Meetings are the third most used information sharing tool and 73 percent of the respondents receive information during meetings. Some information is shared by PL (42 percent) and during spontaneous meetings the corridors (40 percent). It should also be mentioned that employees go and talk to each other when they have questions. However, at times, PE thinks that SP can find some answers by themselves, but asks PE instead because it is easier. Some employees mention that there is a “we and them” relation between PE and SP. Some design engineers at PE mentions that they find it beneficial to have the production under the same roof. There are contradictory opinions whether PE visit the production or not. A number of design engineers at PE mention that they go and visit the production, but at SP the experience is that this is not the case.

The goods that are shared are mainly information about simple re-designs (71 percent), EEH-errands (62 percent) and new designs (56 percent). Of the design engineers at PE that have contact with SP, 36 percent mentions that the received information regards large re-designs. When test accommodations are being to be build, SP asks PE for the required information regarding the production specifications. Information regarding reparations, failures and authentication is also shared between the divisions.

Of the respondents at PE, three percent receive information on a daily basis, 18 percent receive information weekly, 43 percent monthly and eight percent receive information yearly.

A summary of the links between PE and SP, the information type and the frequency is found in Table 5.

Table 5. A summary of the most commonly used links, the information type and the frequency of the information sharing.

Links	Information Type	Frequency
Email & phone calls	Downstream information	Monthly & weekly

Information Sharing between PE and PU

There are several information sharing tools that are used between PE and PU. 94 percent of the respondents receive information by email and 87 percent by personal interactions. Meetings are the third most used method, followed by spontaneous meetings and phone calls. 42 percent receive information through PL.

At the interviews, it was mentioned that most information is regarding changes and updates on the existing products. Changes can either be on the product itself or on related documents. It is most common that the information concerns new designs (71 percent) but also information regarding simple re-designs (58 percent) and interfaces (55 percent) are received from PU. 35 percent of the respondents receive information regarding EEH-errands from PU. Information can also regard reparations, failures and changes in IFS.

The frequency of the information is mainly weekly (15 percent) or monthly (27 percent). Of the respondents, 10 percent receive information on a daily basis and two percent receive information a couple of times every year.

A summary of the links between PE and PU, the information type and the frequency is found in Table 6.

Table 6. A summary of the most commonly used links, the information type and the frequency of the information sharing.

Links	Information Type	Frequency
Email & personal interactions	Product information	Monthly & weekly

Information Sharing between PE and PK

84 percent of the design engineers at PE goes and talk to the engineers at PK when information is required. It may also be that the engineers from PK go to PE and report information. Much of the information is also sent by email (80 percent). 61 percent answered that they receive information from PK in meetings, and 41 percent receive information via phone calls. 39 percent receive information with PK during spontaneous meetings in the corridors, and 36 percent receive information via the sub-project manager. The information may also be received from IFS, or it may be communicated by the line manager. One of the respondents also mentions the use of the internal chat.

The general opinion at PE is that the information sharing between PE and PK is good. PE and PK used to be the same division, which has resulted in a close collaboration between the two divisions. There is often a compromise between PE and PK regarding the design; however, it is easy to find a good balance due to the good communication. PE and PK work as a team when the designs are created, hence, information is shared all the time. It is also mentioned that some work at PE inter-relates with PK in the product development process.

61 percent of the information that PE receives from PK treats new designs and 45 percent treats interfaces. One respondent also bring up interface specifications as one information element. Another respondent bring up cable drawings and cable lists. The information may also treat simple re-designs (32 percent) or EEH-errands (25 percent). Some of the respondents mention that the shared information may be about verification of different units.

Most of the respondents (35 percent), receives information a couple of times per month. 28 percent receives information weekly and five percent receives information daily. 12 percent receives information a couple of times per year. One of the respondents also answered that there exist a weekly informal meeting with the line manager at PK.

A summary of the links between PE and PK, the information type and the frequency is found in Table 7.

Table 7. A summary of the most commonly used links, the information type and the frequency of the information sharing.

Links	Information Type	Frequency
Personal interactions & email	Product information	Monthly & weekly

Information Sharing between PE and DO

Most of the contact from DO to PE goes through PL. At times, DO asks the design engineer without contacting PL. At CCB-meetings DO, PL and engineers are gather and discuss the product changes.

It is mainly PRIs or information regarding PRIs that is the information shared between DO and PE. It is DO's responsibility that all the concerned divisions get information about product changes.

A summary of the links between PE and DO and the information type is found in Table 8.

Table 8. A summary of the most commonly used links and the information type.

Links	Information Type
PL & meetings	Product information

5.1.2 Visualisation of the Information Flow

One of the core values in Lean Thinking is creating customer value (Liker, 2004). It is therefore important to know who the next customer in the chain is. To get a holistic view of the system two flows are visualised. First the product development process and its related information flows, and secondly the change request process and its related information flows are visualised. The processes and flows are based on the interviews at OEG. This sub-chapter deals with OEG's Lean aspects *Visualise* and *Look at the whole*.

Swim Lane Flow Chart

A tool for mapping information flow is the Swim Lane Flow Chart. It is a mapping tool that is easy to use and easy to understand (Burns, 2007). The Swim Lane Flow Chart shows what is done, by whom it is done and when it is done, i.e. in what sequence tasks are performed (Burns, 2007; Durugbo, et al., 2011). It is a horizontal flow chart where the process starts from left and moves to the right (Durugbo, et al., 2011). The activities are organised and categorised into different pools or swim

lanes (White, 2004). The pools represent different business parts, for example a company and a customer or a doctor and a patient (White, 2004). The swim lanes represent different resources or divisions within the pool and are illustrated with horizontal lines (Burns, 2007).

According to Expert 3, a Swim Lane Flow Chart shows the actual case where both the product, downstream and management information types are shown in a visible way. It is important to avoid using the set processes when mapping; instead it is the information gained from the interviews and the questionnaire that are the basis for the mapping. By mapping this way it is possible to catch information of how the employees actually perform tasks.

Product information and downstream information are separated from the management information in the chart; the solid line shows the product information and the downstream information (sequence flow) while the dashed line shows the management information (message flow).

In Swim Lane Flow Charts, different symbols are used, see Figure 16. The symbols are standardised symbols and are used for several of different mapping tools (White, 2004).

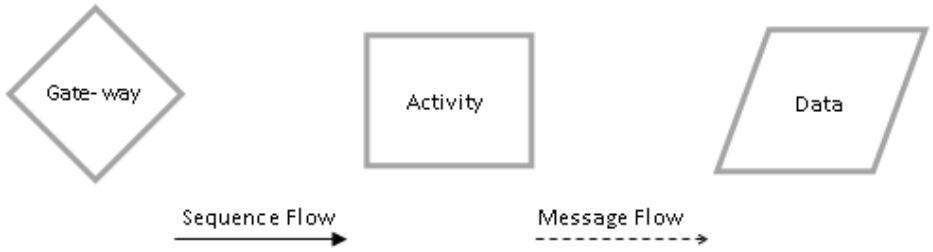

Figure 16. Different symbols that are used in a Swim Lane Flow Chart.

A gate-way is used to show decisions. Sometimes it is followed by a “yes” or a “no”. An activity is a work task that is being performed and data is any kind of information or data (White, 2004).

The Product Development Process and its Related Information Flow

With the interviews at OEG as input, the product development process and its related information flow are visualised in the Swim Lane Flow Chart in Figure 17.

The Change Request Process and its Related Information Flow

In Figure 18, it is shown how the change request process and its related information flow are. The chart zoomed in from Figure 17 and is based on the interviews at OEG.

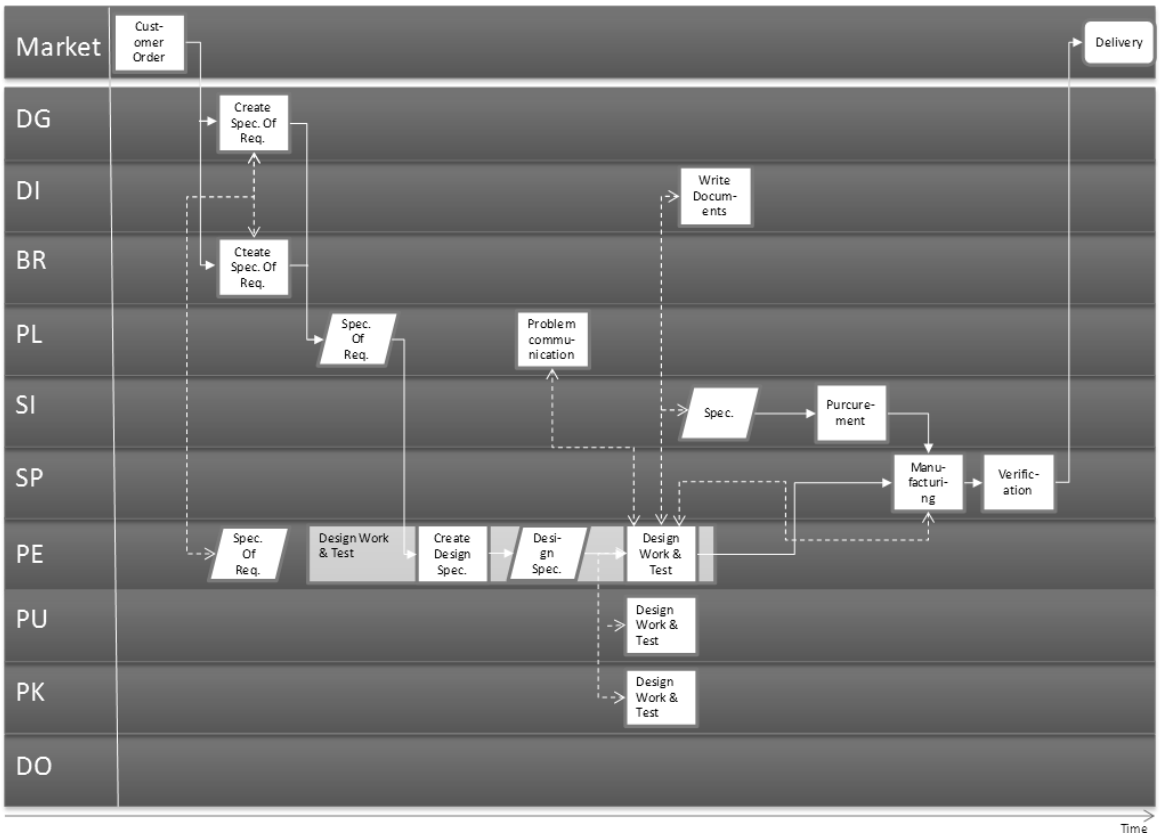

Figure 17. The Product development process and its related information flows.

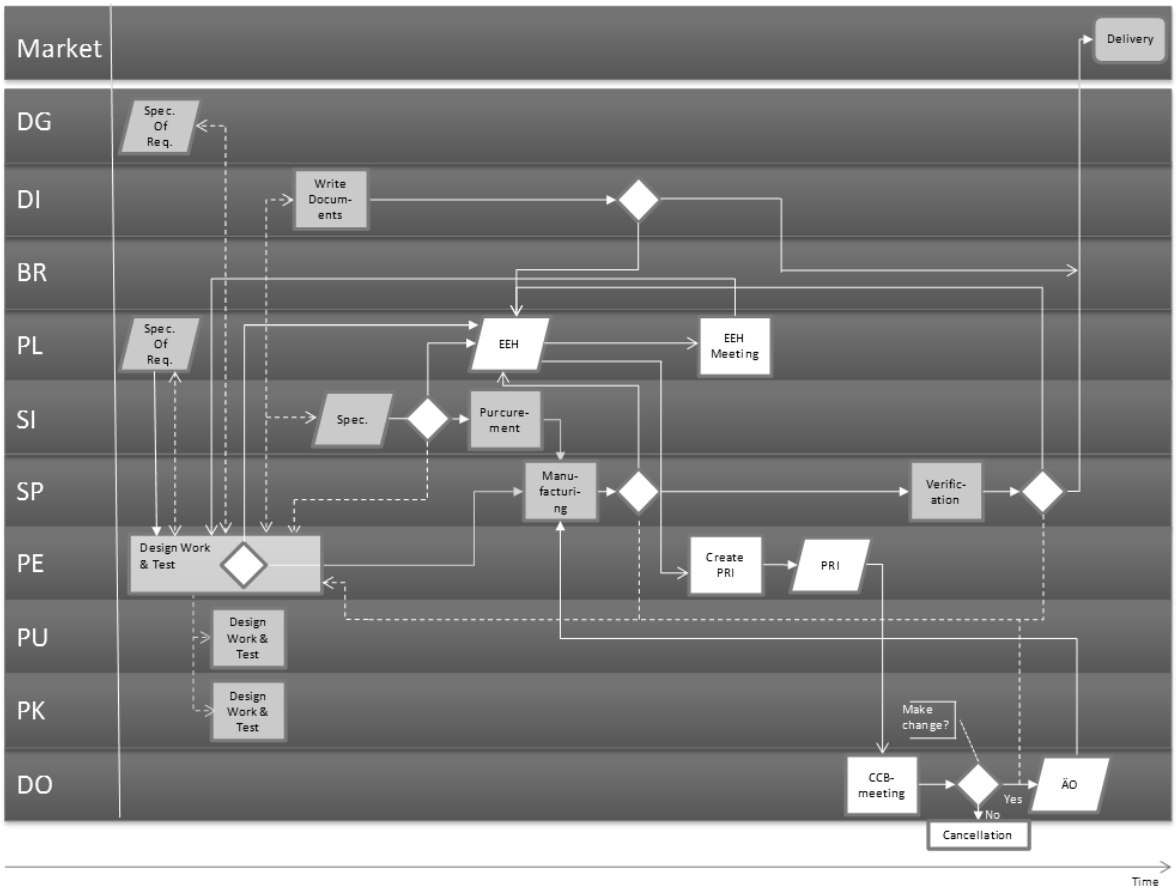

Figure 18. The change request process and its related information flows.

5.2 Barriers in the Information Flow

People are often affected by the organisation´s culture, the collective knowledge, the imagination and by the set rules. This may result in barriers between the different divisions in an organisation. Hence, it is necessary to improve the information flow and communication between the divisions. Before the information flow is improved, it is important to be aware of the certain information sharing barriers that prevent the information flow between the divisions.

According to the theory, nine categories of waste can occur in product development processes. Wastes are barriers for the information flow. From the interviews and the questionnaire, waiting, motion and rework have been mentioned by many employees to be the main wastes in the product development at OEG. Waiting can occur due to poor information quality, and motion is referred to when people must spent time on finding persons, documents, meetings etc. Rework may for example occur due to changes of requirements. Waiting, motion and rework creates time delays, time that otherwise could be used to create customer value. In order to avoid time delays, it is important that the information is of high quality.

5.2.1 Barriers between PE and the Other Divisions at OEG

In this sub-chapter, barriers between PE and the other divisions at OEG are presented. The barriers are found from a combination of literature and empirical data. The second research question is analysed in this sub-chapter: What are the main barriers for the information flow between PE and the other divisions at OEG? This sub-chapter deals with OEG's Lean aspects *Right to you* and *Value for customers*.

Barriers between PE and DG

From the questionnaire, the majority of the respondents think that the information that PE receives from DG is complete at times. The rest of the respondents think that the information is complete most of the time. It is also found that the information from DG sometimes contains too little information. Many of the answered also think that the information from DG most of the time contains too little information. Sometimes, PE receives too much information, but most commonly not. Further on, it is found from the questionnaire that PE sometimes receives information from DG too late. The information from DG is also most of the time concise and understandable, which is something that should be remained and further improved.

When the information from DG is incomplete and contains too little information, the design engineers either have to wait for additional information, search for more information or to start working without all required information. Waiting is a waste, and so is searching in form of motion. To start working without having all the required information may lead to rework, which also is a waste. Waiting, motion and rework build up barriers between PE and DG. Rework is confirmed by the interviews, where it is found that a sufficient amount of rework is required. Too much information received is related to the waste overproduction. There is a gap between the customer requirements and the requirements of specifications. This gap may be one reason to why the design engineers experience that they sometimes receive too little information. Further, when too much information is received, filtration of the information is necessary, which takes unnecessary time from the design engineers and contributes to the barrier.

When the design engineers receive information too late they most often start working without having all required information, which may result in rework or on spending unnecessary time on

finding the required information. Rework may also be a consequence of the gap that occurs between the requirements of specifications and the product design. Unnecessary communication between PE and DG is required when the employees start working before the specifications of requirements are set.

A summary of the most significant information quality issues and wastes that contribute to the barriers between PE and DG can be found in Table 9.

Table 9. The most significant information quality issues and wastes.

Information quality dimensions	Wastes
Complete, appropriate amount & timely	Waiting, motion, rework & overproduction

Barriers between PE and DI

From the questionnaire, it is found that the information that PE receives from DI sometimes or most of the time is complete. However, the information that PE receives sometimes contains too little information. At the same time as PE sometimes receive too little information, it has been mentioned by DI that they do not always receive the information from PE that they need. Half of the respondents to the questionnaire mean that PE sometimes receives too much information from DI. An equal number of respondents mean that the information that they receive almost never contains too much information. About half of the respondents to the questionnaire think that the information from DI sometimes is concise and understandable. On the other hand, the other half thinks that the information is concise and understandable most of the time.

Incomplete information from DI may lead to wastes in form of waiting for additional information or on spending time on searching for additional information. Too little information results in wastes in form of waiting and motion and creates barriers between PE and DI. When the design engineers receive too much information, filtration is necessary which takes unnecessary time and contribute to the barriers. o

When the information is not concise and understandable, the design engineers must either guess what the information means, or ask the provider of the information. Consequently, unnecessary time is spent on understanding what the information means. Hence, another barrier between PE and DI is created.

A summary of the most significant information quality issue and wastes that contribute to the barriers between PE and DI can be found in Table 10.

Table 10. The most significant information quality issue and wastes.

Information quality dimension	Wastes
Complete & appropriate amount	Waiting, motion & overproduction

Barriers between PE and BR

Generally, PE and BR do not have direct contact. Most of the information is transferred through the sub-project manager. Consequently, PE and BR do not directly share information.

Barriers between PE and PL

From the questionnaire, it is found that the information that PE receives from PL most of the time is regarded as complete. Sometimes too little information is received and sometime too much information is received. However, from the questionnaire and the interviews it is also found that PL is good at providing the design engineers with the right information. Also, the information from PL is regarded as concise and understandable with the right language, format and structure. The information that PE needs is most of the time received in the right time, but many of the respondents think that this is only sometimes true. The information is almost never too early, but is sometimes too late.

The consequences of the wrong amount of information are waiting or motion and create a barrier between PE and PL. When information is received too late, the design engineers either have to wait for the required information or ask PL about the required information, which increases the communication and takes unnecessary time. Or, the design engineers start working without the right information, with rework as a consequence.

A summary of the most significant information quality issues and wastes that contribute to the barriers between PE and PL can be found in Table 11.

Table 11. The most significant information quality issues and wastes.

Information quality dimensions	Wastes
Timely & appropriate amount	Waiting, motion, rework & overproduction

Barriers between PE and SI

From the questionnaire, it is found that the information that PE receives from SI is sometimes or most of the time regarded as complete. Sometimes the information received from SI contains too little information. Most of the respondents think that the information almost never contains too much information. The information that PE receives from SI is most of the time regarded as concise and understandable by half of the respondents to the questionnaire. The other half thinks that the information only sometimes is concise and understandable. From the interviews it was found that SI sometimes receives information from PE too late.

When the information is incomplete, the design engineers either have to wait of additional information or spend unnecessary time on finding additional information. Too little information results in that the design engineers either have to wait for complete information, spend unnecessary time on finding more information, or start working without having all required information. This creates barriers between PE and SI. When the information is not concise or understandable, the design engineers might have to spend unnecessary time on understanding the information. Too late information results in that SI must wait for the required information.

However, from the interviews it was found that there is a close collaboration between the design responsible for a specific product at PE and the purchaser for that specific product at SI. It is important to maintain and improve the collaboration.

A summary of the most significant information quality issues and wastes that contribute to the barriers between PE and SI can be found in Table 12.

Table 12. The most significant information quality issues and wastes.

Information quality dimensions	Wastes
Complete, timely & appropriate amount	Waiting & motion

Barriers between PE and SP

From the questionnaire, it is found that the information that PE receives from SP most of the time is complete. Sometimes the received information is in the wrong amount. The information is most of the time considered as being concise and understandable, which is something that should be maintained. It was mentioned by SP that they do not always get the required information in time.

If the design engineers receive too little information, they might have to wait for additional information, spent unnecessary time on seeking for more information or start working without having all required information. Consequently, it results in rework and creates a barrier between PE and SP. When PE receives too much information, filtration is necessary, which takes unnecessary time.

When SP does not receive the required information in time, SP asks PE for the information. This creates a need for more communication that results in unnecessary time spent on communication. Also, PE believes that SP can find the answers to some of the questions by themselves. The uncertainty about when it is accepted for SP to ask question contribute to the barriers.

According to the theory, there exist sub-cultures within organisations. The sub-cultures have their own language, which result in a well functioning collaboration within the sub-cultures. However, the sub-cultures also result in information sharing barriers between the divisions. SP experience a feeling of “we and them” between PE and SP, which contributes to the barriers.

A summary of the most significant information quality issues and wastes that contribute to the barriers between PE and SP can be found in Table 13.

Table 13. The most significant information quality issues and wastes.

Information quality dimensions	Wastes
Timely & appropriate amount	Waiting, motion & rework

Barriers between PE and PU

From the questionnaire, it is found that the information from PU most of the time is complete, concise and understandable. Most of the respondents to the questionnaire think that the information from PU sometimes contains the wrong amount of information. However, at the same time many of the respondents do not receive too much information. Some of the respondents think that the information received from PU comes in the right time. The information is never received too early but sometimes too late.

Too little information results in that the design engineers must wait for or find additional information or start working without having all required information. This creates a barrier between PE and PU. When too much information is received it has to be filtrated, which results in unnecessary time spent

on sorting out information. When information is received too late it may result in waiting, motion and rework and might contribute to the barriers between PE and PU.

A summary of the most significant information quality issues and wastes that contribute to the barriers between PE and PU can be found in Table 14.

Table 14. The most significant information quality issues and wastes.

Information quality dimensions	Wastes
Timely & appropriate amount	Waiting, motion, rework & overproduction

Barriers between PE and PK

From the questionnaire, it is found that the information that PE receives from PK most of the time is complete. The information sometimes contains the wrong amount. Further, it is found from the questionnaire that the information from PK is received by PE in the right time. However, the information is sometimes received too late. The information from PK is regarded as concise and understandable with the right language, format and structure.

The consequences of the wrong amount of information are unnecessary time spent on finding information and rework. Too late information also contributes to time delays and rework.

PE and PK used to be the same divisions, which has resulted in a well functioning collaboration. This should be maintained and further improved.

A summary of the most significant information quality issues and wastes that contribute to the barriers between PE and PK can be found in Table 15.

Table 15. The most significant information quality issues and wastes.

Information quality dimensions	Wastes
Timely & appropriate amount	Waiting, motion, rework & overproduction

Barriers between PE and DO

The information that DO receives from PE is at times on a high technical level and the information can be difficult to understand. It sometimes happens that PE forget to send information to DO, hence the information is receive too late.

A summary of the most significant information quality issues and wastes that contribute to the barriers between PE and DO can be found in Table 16.

Table 16. The most significant information quality issues and wastes.

Information quality dimensions	Wastes
Understandable & timely	Motion & waiting

5.2.2 General Barriers in the Information Flow

In this sub-chapter, general barriers that cannot be directly connected to specific interfaces are analysed. The OEG Lean aspects that are considered in this sub-chapter are *Right to you*, *Common view* and *Look at the whole*.

Processes

It is found from the interviews that set processes are not always followed. Both the structure of the projects, the methods that are used and the processes differ from project to project. At PE, the same employee is involved in several different projects with different work tasks, which creates variance in how to work. Variance is also created when processes are not followed and will most probably result in rework. Further, when processes are not followed, the concerned divisions might not get the required information. For example, errors and problems are communicated though several different information channels, which may result in that the errors or problems falls through the cracks. The errors may also be forgotten and in the worst case not handled at all.

Liker (2004) mentions the importance of flow visibility of processes to immediately find a problem when it occurs. If the processes are followed, it is easier to find the root cause for errors and also to ensure that quality issues do not evolve from the processes. It is also important to follow processes to achieve process simplifications and continuous improvements.

Hence, to not follow set processes and methods, results in variance and prevents flow visibility. This does not direct create barriers, but contributes to already existing barriers.

EEH and PRI

From the interviews it is found that the change request documents, EEHs, confuses and creates barriers. There are many different opinions about how and when an EEH-errand should be created and how the change process should proceed. Some claim that an EEH should be created every time an error is detected, while others prefer a phone call or an email instead. The common view amongst the interviewees is that there are no set rules for when an EEH should be created and when it should not. Neither are there any set rules for when an error should be communicated via an EEH or via a meeting. How the employees do, depends both on how long time they have been working at OEG and on the personal network.

If an EEH is not created, the information about the problem may fall through the cracks. Also, the design engineers can terminate an EEH, which creates confusion among the person who created the EEH whether the EEH is handled or not. Further, the design engineers sometimes forget to send the PRI to DO (PRIs are not sent automatically), which result in that no changes are made on the product. This contributes to confusion. The confusion creates barriers between PE and the one who created the EEH. Further on, some of the interviewee means that the PRIs sometimes are difficult to understand, since they are written in English, are on a high technical level, contain too much information and are complex. The receiver must then spend unnecessary time to understand the information. Hence, this also contributes to the barrier. However, from the questionnaire, it is found that most of the respondents think that the PRI are good at providing good information. This is regardless of how long time the answered have been working at OEG, see Figure 19.

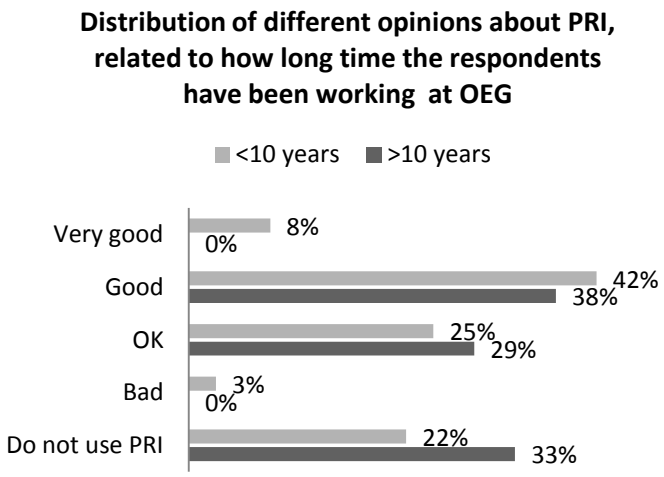

Figure 19. Distribution of different opinions about PRI, related to how long time the respondents have been working at OEG.

IFS

From the questionnaire, it is found that IFS is good at providing the design engineers with the right information. In Figure 20, it is shown how many of the respondents that think IFS is good at providing the right information, related to how long time the respondents have been working at OEG. The figure clearly shows that most of the respondents think that IFS is good at providing the right information, regardless of how long time the answered has been working at OEG.

Some of the interviewees mention that it may be difficult for new employees and for those who do not use IFS in their daily work to find information in IFS.

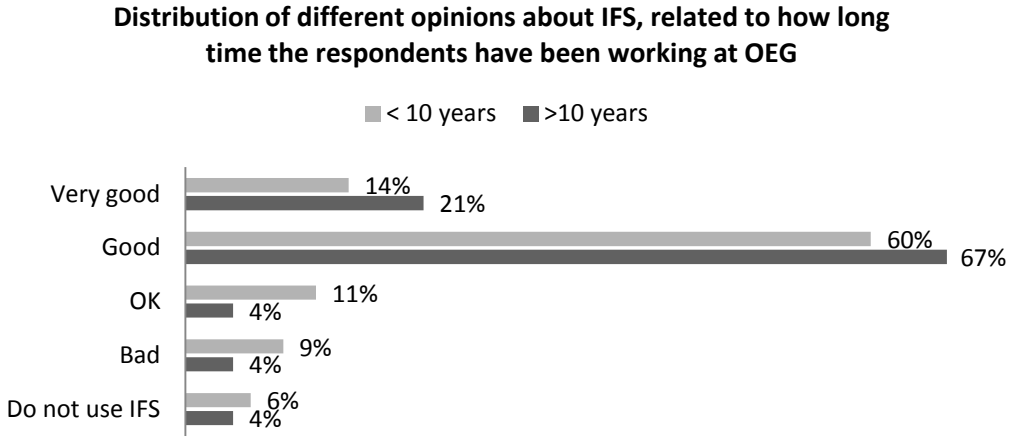

Figure 20. Distribution of different opinions about IFS, related to how long time the respondents have been working at OEG.

Since most of the respondents find IFS good at providing the right information, IFS do not directly contribute to the barriers.

Meetings

From the interviews, it is found that a lot of information is shared at meetings. From the questionnaire it was found that 55 percent of the respondents find the meetings good at providing

the right information. 25 percent find the meetings very good at providing the right information, and 20 percent find the meetings okay at providing the right information. No one of the respondents find the meetings bad. Hence, the meetings do not create any barriers.

Specifications

It is found, both from the interviews and from the questionnaire, that the specifications of requirements often are late. Some of the interviewees mean that the specifications are late due to that the sales process takes long time. Consequently, everyone start working before they have all required information.

However, the questionnaire also shows that the specifications of requirements and the design specifications are good or okay at providing the design engineers with the right information. 45 percent think that the specifications are good and about 30 percent find them okay. Hence, the specifications themselves do not create any barriers, but the time aspect must be considered.

Experience

Most of the interviewee mentioned that they ask someone within their personal network when information is required. Informal information channels such as emails, phone calls and meetings are used. For newly employed, it can be difficult to know who to contact. At the internal Wiki, documents that specifies which person who is responsible for certain components can be found. However, the documents does not include information of who to ask certain questions or which persons that have specific knowledge. For newly employed, it may require several emails or phone calls before the right persons, the right information or the right documents are found. Unnecessary time is then spent on searching for information. There exists no formal information sharing system where information easily can be found. Most often, experienced employees with a large personal network contact persons within the personal network. It must also be mentioned that sharing information within the personal network may create honest and smooth information sharing between the persons involved. However, the provider of the information may be occupied in another project than the receiver. Hence, time is taken from the provider´s project.

5.3 How to Reduce the Barriers to Improve the Information Flow

In this sub-chapter, methods and tools for reducing the barriers are described. According to the theory, it is important that improvements and processes are in correlation with the organisation´s core elements and with the principles of Lean. Hence, the methods and tools which are suggested to be implemented are in line with OEG's view on Lean and in particular the seven Lean aspects considered in this research, see Figure 15.

As described in the theory, the right information should be shared in the right amount, to the right people, in the right time and to the right place. It is also important to consider how the information is shared and that the right information is shared. Information should travel short distances, fast and directly from the supplier to the user without any barriers. It is important to find the root causes for the barriers before finding a method that reduces the barriers. Methods and tools that are presented in theory and by other companies should not be directly copied. Instead, the methods and tools should be modified to capture the problem that they aim to reduce.

Further on, improvements should be measured to the outmost, if it is possible. Improvements must not only be measured in QDE-terms (Quality, Delivery, Economy) since it may be difficult to deduce a

certain KPI with a specific improvement. Improvements may also be measured in “soft factors”, e.g. emotions. It is important to consider how the employees experience the situation.

5.3.1 How to Improve the Information Flows between PE and the Other Divisions

The most significant information quality issues are incomplete information, wrong amount of information and non-understandable information. Also, information that is received too late is a significant information quality issue. These quality issues contribute to the wastes waiting, motion, rework and overproduction. The wastes are barriers for a smooth information flow. Some barriers also occur due to sub-cultures and unnecessary communication.

In the theory, a number of authors points out the importance of standardisation. Standardisation serves as a reference point from which improvements are made. One of the authors points out that the information should contain standardised and the same symbols and language, which contribute to a greater understanding of the information. Also, a standardised data format will ease the use of common terms. Further, the information should be shared and transferred in a standardised way. Today, information is spread through many different information sharing channels, which contribute to confusion and time delays. To use the same channel for the same information will contribute to reducing confusion and time delays.

According to the theory, a shared vision with clear goals creates a domain of interest and helps to keep the right focus when searching or providing information. The focus helps the provider of the information to not send too much information, and will also help the receiver of the information to filter out the right information.

According to Expert 2 and Expert 4, a powerful tool to use when flows are to be improved is to have a workshop with the concerned instances, for example with some of the design engineers and some of the employees from SP. At the workshop, the current information flow map may be shown and discussed to find better, smarter and more efficient flows. Further, it may be discussed what type of information that is required, what the information should contain, how much information that is required, when the information is needed, by whom, to where the information should be sent and how the information should be shared. The result of the workshop may be new standards of information sharing that will simplify the processes and enable continuous improvements. The standards may be committed as a checklist, so that when information is to be shared, the provider can look at the checklist and make sure that the set standard is followed. However, according to the theory, the standards are not set in stone. Rather, the standards should be updated and improved continuously.

Since the workshops enable communication between the divisions, they may also contribute to reducing the sub-cultures. Another tool to use to reduce the sub-cultures is “go and see”. At Ericsson, there are daily reviews every morning at the production. This is something that OEG may also introduce. During the reviews, SP can tell what problems they have encountered. The participants at the review (PE, DO and other concerned instances) will then get important information about problems with the product. “Go and see” may also be used for the employees to get a holistic view of the product or project.

To reduce the gap between PE and DG it is important that the sales structure is in line with the product strategy. It is important to create a continuously learning organisation and to spread

information about the product and the company values throughout the organisation. It is a common phenomenon that little attention is paid to the sales structure. The sales structure is most often the first instance that has contact with the customer (Calabrese, 1999). It is the changes in the requirements that result in the first two gaps between customer demands, requirement specification and product design. The gap is not wide but it is still important to reduce the gap as much as possible. It is the management's responsibility to make sure that the companies divisions are integrated and work towards a common goal. The third gap occurs between the product design and the process design. It is therefore important that set processes are followed, which was mentioned both at the study visit at RUAG Space AB and Ericsson AB. The people who are actually working with the processes should develop them after how they work. The last gap occurs in the production. It is important to not only hand over information to the next process in the chain, it is also important to have cross functional communication.

Even though it is important to improve the current information flow, it must not be forgotten to maintain the well functioning collaboration between PE and PK. One way to do so may be to keep a close collaboration and to create standard routines for doing so.

A long-term solution for reducing the rework is to introduce concurrent engineering and set based design. Today, much rework is required due to that the information is received too late. With concurrent engineering and set based design, the design functions within a certain span. When the information with the right specifications or tolerances is received, the design may still function. It the design instead was a one-point solution, the design might have had to be re-made in order to fulfil the requirements. Also, when applying concurrent engineering, with its cross-functional teams, information may not be too late at all.

Table 17 summaries and clarifies the improvement suggestions for how to improve the information quality and reduce the wastes.

Table 17. A summary of what improvement suggestions that contributes to higher information quality and reduction of wastes.

Improvement suggestion	Information quality issues	Wastes to be reduced
Standardisation	Understandable, appropriate amount, complete & timely	Waiting, motion, rework & overproduction
Shared vision	Appropriate amount	Waiting, motion & overproduction
Checklist	Understandable, appropriate amount, complete & timely	Waiting, motion, rework & overproduction
"Go and see"	Understandable	Motion
Follow set processes	Understandable, appropriate amount, complete & timely	Waiting, motion, rework & overproduction
Cross functional communication	Understandable, timely	Waiting & motion
Set based concurrent engineering	Timely	Rework

5.3.2 How to Improve the General Information Flows

It is most often the project manager who determines how the project process is and what processes to follow. It is positive that the project manager has total command, but it is equally important to follow standardised processes and to work according to the same processes throughout the organisation. The teams should establish standards for how to manage information that concerns the project. Workshops can be used for developing standards in projects. The line management should have the responsibility for the improvement of the processes.

Regarding the change request process, it is important to have a system where the right information is sent and where information cannot get lost. All the EEHs should be uploaded into the system. If an EEH is not uploaded in the correct way, it should be sent back. By handling EEHs in this way, the one who has created the errand must go through it one more time, and no errands will fall through the cracks. When problems are detected in the production, a fault report should be created and uploaded. Ericsson AB has experienced that handling problem by the creation and uploading of fault reports has resulted in a more efficient problem solving process. Also, errands should be handled as soon as possible in order to avoid time delays and confusions whether the EEH has been handled or not. When SP detects problems in the production, they should first try to fix the problem themselves, and there after create and upload a fault report. The fault report should be handled as soon as possible.

OEG has an internal Wiki, which should work as a technical knowledge sharing database where information is spread. It should also work as a link between the personal level and organisational level, since the information that one person possesses should be shared within the organisation. Such a system would also help newly employed to find the right information. It is not found that re-invention is a problem, but if it is easy to find old solutions and use them, re-invention can be avoided. Hence, the Wiki could be further developed to a system that shares knowledge and information about products, technical issues and problem solving. Information should be added to the Wiki in a standardised way so that information easily can be accessed.

A system or document that shows who is responsible for different tasks, has expertise in specific areas and what projects the person is involved in, would make it easier for the employees to find the right person.

It has been mentioned that IFS is a well functioning system that is easy to use for those who use it in their daily work. However, product information of different complexity are today stored at the same level. There are mainly two things that employees have mentioned that they want to improve with IFS. First, it would be beneficial to have a search engine and secondly, the product information should be stored in a more logical way. Information should be added to IFS in a standardised way.

The meetings function well but it would be beneficial to have a standardised form when sending out meeting requests. The standardised form may include the subject, purpose and agenda of the meeting. In that way it is possible to ensure that the participants are prepared and that the right people are invited. This is a function that has been implemented at RUAG Space AB that have experienced that the meetings has become more efficient after the implementation.

In the long-run, it should be considered to go from multi-tasking to single-tasking, i.e. that one resource is involved in one project at the same time, not several. The employees may be more

focused on the specific task and the set-up time is minimized. There are a number of experts at OEG who could work as contact persons and function in several projects.

In Table 18, the improvement suggestions and the possible results are summarised.

Table 18. A summary of the improvement suggestions and the outcomes.

Improvement suggestion	Expected result
Standardise and follow processes	Less rework
System for EEHs and failure reports	Right information is sent to the right person & information do not fall through the cracks
Develop the Wiki	Easily accessed knowledge
System or document of responsibilities/expertise	Easier to find the right person
Implement a search engine and a standardised way to store information in IFS	Product information is more easily accessed
Standardised meeting form	Efficient meetings, right persons at the meeting & prepared participants
Single-tasking	Better focus

6. Result

In this chapter, the result of this research is presented. The result is based on the analysis and answers the three research questions.

6.1 Information Flow between PE and the Other Divisions at OEG

This sub-chapter answers the first research question. The links, the information types and the frequency of the information that is shared between PE and the other divisions at OEG are presented.

The divisions that PE has most contact with are PL, SP and PK, followed by SI and PU. PE has least contact with DI, DG and BR. The links between PE and the other divisions are shown in Table 19. Since PE and BR do not have direct contact normally, BR is not included in the table.

Table 19. The links that are most frequently used between PE and the other divisions.

Division	Links
DG	Meetings & email
DI	Meetings & email
PL	Meetings & email
SI	Email & phone calls
SP	Email & phone calls
PU	Email & personal interactions
PK	Personal interactions & email
DO	PL & meetings

The type of information shared between PE and the other divisions is primarily product information, but also downstream information is shared. The primary information types that are shared between the divisions are presented in Table 20.

Table 20. The primary information types that are shared between PE and the other divisions.

Division	Information types
DG	Product information
DI	Product information
PL	Product information & downstream information
SI	Product information
SP	Downstream information
PU	Product information
PK	Product information
DO	Product information

There is monthly information sharing between PE and all of the other division. On a weekly basis, the information sharing between PE and PL is significantly higher than the information sharing between PE and other divisions. PE receives information on a yearly basis from DG and DI. On daily basis, PE receives information mostly from PL, PU and PK. A small number of employees receive information daily from DG and SP. In Table 21, the frequency of the information sharing between PE and the other divisions at OEG is presented.

Table 21. The frequency of the information sharing between PE and the other divisions.

Division	Frequency
DG	Monthly & yearly/weekly
DI	Monthly & yearly
PL	Weekly & monthly
SI	Monthly & weekly
SP	Monthly & weekly
PU	Monthly & weekly
PK	Monthly & weekly

6.2 Barriers in the Information Flow

The second research question is answered in this sub-chapter. The information quality dimension issues and the wastes, together with the links and frequency, contribute to the perceived distances between PE and the other divisions. The barriers and distances are presented in this sub-chapter.

In Table 22, a summary of the information quality dimensions and the related wastes that have been found to be of greatest issues is shown. The information quality dimension issues together with the wastes contribute to the barriers between PE and the other divisions. PE and BR do not directly share information and therefore no barriers between the two divisions were found.

Table 22. The information quality dimension issues and the related wastes.

Division	Information quality dimensions	Wastes
DG	Complete, appropriate amount & timely	Waiting, motion, rework & overproduction
DI	Complete, appropriate amount	Waiting, motion & overproduction
PL	Timely & appropriate amount	Waiting, motion, rework & overproduction
SI	Complete, timely & appropriate amount	Waiting & motion
SP	Timely & appropriate amount	Waiting, motion & rework
PU	Timely & appropriate amount	Waiting, motion, rework & overproduction
PK	Timely & appropriate amount	Waiting, motion, rework & overproduction
DO	Understandable & timely	Motion & waiting

From the general barriers, it is found that when processes are not followed, a variance is created. This contributes to already existing barriers. There are many different opinions about EEH. However, the main finding is that EEH is confusing. The confusion creates barriers between PE and the one who created the EEH. IFS has been found to be good at providing the right information, hence, IFS do not contribute to the barriers. Meetings and specification are also good at providing the right information and do not contribute to the barriers. Finally, it is found that it may be difficult for newly employed to find the right person or the right information.

The distance between PE and the other divisions depends on the links, the frequency, the information quality dimension issues and the wastes. The distances between the divisions may be seen as the virtual distance between the efficient islands. In Figure 21, the distances is visualised in line with the concept of efficient islands in an inefficient ocean.

Figure 21. Sea chart over the distances between the efficient islands within an inefficient ocean.

6.3 How to Reduce the Barriers to Improve the Information Flow

The proposals of how the barriers can be reduced to improve the information flow are in line with OEG´s view on Lean. The proposals are presented in Table 23.

Table 23. Improvements suggestions for how to improve the information flow.

Improvement suggestion
Standardise the symbols, language, format and how the information is sent.
Communicate a shared vision and clear goals to all of the employees.
Have workshops when developing standards for information sharing with the employees that work within the processes.
Use checklist when sending information.
Use “Go and see” to follow the product that is developed.
Follow set processes and review the standards if the processes are not followed. Improve the process standards continuously.
Communicate cross functionally during the entire developing phase.
Move towards set based concurrent engineering.
Standardise and follow set process for projects.
Have a workshop when developing standards for how to work in projects.
Develop a system that handles EEHs and failure reports.
Develop the Wiki to a technical knowledge sharing database.
Create a system or document that shows who is responsible for different tasks, has expertise in specific areas and what projects the person is involved in.
Implement a search engine and a standardised way to store information in IFS.
Use a standardised form when sending out meeting requests.
Go from multi-tasking to single-tasking.

7. Discussion

The purpose of this research was to find barriers for the information flow and to locate improvement areas. The result of this research answered the three research questions. Hence, the purpose of the research was fulfilled. The improvement areas contribute to the Lean work at OEG. This chapter discuss some areas that may be of interest to further analyse. Also, recommendations to OEG are discussed.

It is necessary to narrow down the scope of the research in order to get more detailed information. Therefore two processes were followed; the product development process and the change request process. The result would probably be different if other processes are analysed. It may also be interesting to look at and analyse interfaces on a lower organisational level.

By using the Swim Lane Flow Chart the flow was visualised in an easy and clear way. However, the Swim Lane Flow Chart does not consider the activity time. To get the time aspect, the VSM method can be used. It might be interesting to consider the time aspect to find where most time is spent and to find bottlenecks.

To get more data with broader view, it would be beneficial to interview more employees and randomly pick them from other divisions and from other projects. Further, it may be interesting to analyse more deeply how the other divisions experience the information from PE. To collect this information a questionnaire can be used.

Finally, it should be of interest for the single employee to investigate who his or her internal suppliers and customers are. By visualising their own processes, the employees may get a better understanding of their own processes.

7.1 Recommendations to OEG

The methods and tools that were suggested aimed to capture the barriers within the information flow. The authors strongly recommend OEG to implement the methods and tools as soon as possible in order to avoid additional time delays and unnecessary rework. However, some of the methods and tools may create more value or be more difficult to introduce than others. A visualisation of the different methods and tools and their value for OEG versus how difficult they may be to introduce is shown in Figure 22. In the figure, the methods and tools located in the upper left corner should be implemented first. Thereafter, the methods and tools in the lower left corner or upper right corner should be implemented depending on what the company aims at. The following improvement suggestions were found and are recommended to be implemented in the following order:

1. Create a system or document that shows who is responsible for different tasks, has expertise in specific areas and what projects the person is involved in.
2. Standardise the symbols, language, format and how the information is sent.
3. Follow set processes and review the standards if the processes are not followed. Improve the process standards continuously.
4. Use “Go and see” to follow the product that is developed.
5. Have workshops when developing standards for information sharing with the employees that work within the processes.
6. Use checklist when sending information.
7. Use a standardised form when sending out meeting requests.

8. Implement a search engine and a standardised way to store information in IFS.
9. Have a workshop when developing standards for how to work in projects.
10. Standardise and follow set process for projects.
11. Develop the Wiki to a technical knowledge sharing database.
12. Develop a system that handles EEHs and failure reports.
13. Communicate cross functionally during the entire developing phase.
14. Communicate a shared vision and clear goals to all of the employees.
15. Go from multi-tasking to single-tasking.
16. Move towards set based concurrent engineering.

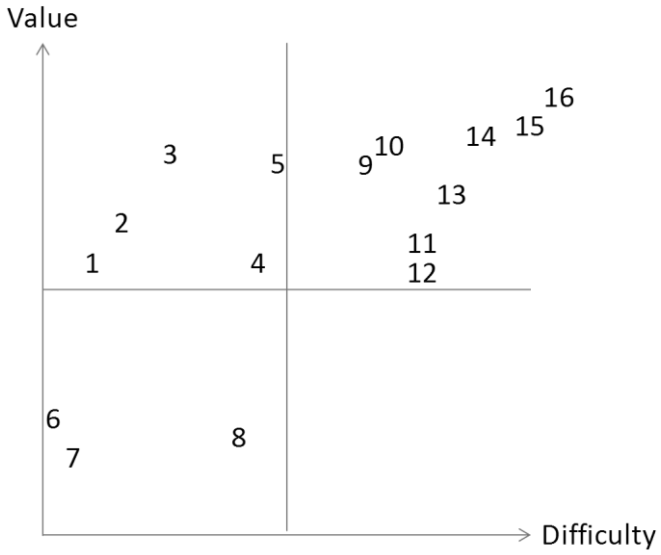

Figure 22. The value versus the difficulty to implement the methods and tools.

Figure 22 was developed by comparing the improvement suggestions with how much they contribute to reducing the barriers and with the effort it may take to implement them. The improvement suggestions number one to fourteen can most likely be implemented relatively fast. The long term suggestions, set based concurrent engineering and to go from multi-tasking to single-tasking, is more complex and may take both time and effort to implement. However, the suggestions are an important part of Lean product development and should therefore be considered in the long run.

8. Conclusion

Companies that aim towards becoming more Lean should move towards flow efficiency. At OEG, the importance of flow efficiency has been realised and a number of employees experienced that there exist barriers for a smooth information flow. The purpose with this research was to find the barriers for the information flow and to locate improvement areas. The improvement areas contribute to the Lean work at OEG.

To answer the first research question, the links, the information types and the frequency of the information that was shared between PE and the other divisions were analysed. It was found that emails and meetings were the main information sharing links. It was further found that the primary information type is product information and that the information sharing frequency is mostly on a monthly and weekly basis. Through visualisation of the product development process, the change request process and their related information flows, it was found that the change request process is complex and contributes to the barriers.

Further, it was found that the main barriers for a smooth information flow are due to the information quality dimension issues incomplete information, wrong amount of information, too late information and non understandable information. These information quality dimension issues contribute to the wastes waiting, motion, rework and overproduction. The wastes also contribute to the barriers. Further, some general information flow barriers were found. One barrier occurs when processes are not followed. Another barrier occurs due to that the EEH process is complex and confusing. It can also be difficult for newly employed to find the right person or right information. This answers the second research question and highlights the main barriers between PE and the other divisions.

How to reduce the barriers and to improve the information flow answers the third research question. First, OEG should implement a system or document that makes it easier for the employees to find the right person. It is also important to implement and follow standards for processes and information sharing. Checklists should be used to ensure that the standards are followed. Further, to reduce the sub-cultures “go and see” should be used more frequently, which also contribute to cross functional communication. The already existing systems IFS and Wiki can be further developed and EEHs and failure reports should be separated in two different systems. It is important to communicate the visions and goals throughout the whole organisation. To reduce the barriers in a long-term perspective, OEG should consider to introduce set based concurrent engineering and to go from multi-tasking to single-tasking.

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Appendix I

The Interview Process

The following steps were used as a guide to ensure that the interviews conducted in this research were successful (Pulliam Philips & Stawarski, 2008).

Determine the type of interview – It is important to determine whether the interview should be structured, semi-structured or unstructured. This is dependent on what approach the interview should have (Qu & Dumay, 2011).

Develop the Questions to Be Asked – In order to get a good response, the questions asked need to be brief, precise, and designed in a way so that they are easy to answer (Pulliam Philips & Stawarski, 2008).

Prepare the Interviewers – It is important that the interviewers are familiar with the questions and the topic (Brewerton & Millward, 2001).

Provide Clear Instructions to the Participants – The interviewee should be informed why the interview is important and how the information will be used (Pulliam Philips & Stawarski, 2008).

Schedule the Interviews – As mentioned above, interviews can be time-consuming. It is therefore necessary to follow a predetermine plan and set aside enough of time for the interview (Pulliam Philips & Stawarski, 2008).

Appendix II

Interview Questions to the Senior Design Engineers

- What are your main work tasks?
- Do you delegate work? How is the allocation of work?
- Customisation: How do you and the design engineers know what to do (through mail/meetings etc.)?
  From whom do you receive information about customisation and who is the receiver of your work?
- Rework: How do you and the design engineers know what to do (through mail/meetings etc.)?
  From whom do you receive information about rework and who is the receiver of your work?
- How is the information flow, describe the two information flows (customisation and rework)?
- Do you experience that the information is
  - *Complete* – the extent to which the information is comprehensive for the task.
  - *Concise* – the extent to which the information can be used directly, without a need for rework before use, in terms of format, content or structure.
  - *Reliable* – the extent to which the information provided is accurate.
  - *Timely* – the extent to which the information is delivered in time and with the right frequency.
  - *Valid* – the extent to which the information measures what is should measure.
  - *Accessible* – the extent to which the information is easy to access when it is required.
  - *Appropriate amount* – the extent to which the information needs filtration.
  - *Credible* – the extent to which the information is accepted or regarded as true, real or believable.
  - *Relevant* – the extent to which the information is appropriate for the task and applications.
  - *Understandable* – the extent to which the information is easy to use and understand.

- What do you think is the reason for rework? Do you need to redesign products?
- What order of priority do you work after? What projects/work tasks come first?

The interviews were conducted in Swedish. Therefore, the Swedish version of the questions is presented below to confirm validity.

- Vad är dina arbetsuppgifter?
- Delegerar du vidare arbetet? Hur fungerar själva arbetsfördelningen?
- Customisation: Hur får du och konstruktörerna reda på vad ni ska göra (mail/möten etc.)? Från vem kommer informationen om customisation? Till vem skickar du vidare ditt arbete?
- Rework: Hur får du och konstruktörerna reda på vad ni ska göra (mail/möten etc.)? Från vem kommer informationen om rework? Till vem skickar du vidare ditt arbete?
- Hur går informationsflödet? Beskriv de två infoflödena (costumisation & rework).
- Upplever du att informationen är:

    - Passande – hur omfattande/heltäckande/innehållsrik är informationen? Är informationen relevant för uppgiften?
    - Konsis – kan informationen användas med en gång, utan att den behöver omarbetas vad gäller format, innehåll och struktur?
    - Trovärdig – är informationen du du får riktig och rätt? Kan du lita på den?
    - I tid – är informationen överlömnad i rätt tid och med rätt frekvens (t.ex. en gång i veckan, en gång i månaden)?
    - Gällande – mäter informationen det som den ska mäta?
    - Tillgänglighet – är det enkelt att få tag på information när det så krävs?
    - Rätt mängd – kommer informationen i lagom mängd, eller behöver informationen filtreras innan den används?
    - Trovärdig (igen) – är informationen accepterad, eller sedd som sann och riktig?
    - Relevant – är informationen ändamålsenlig/lämplig för uppgiften/jobbet?
    - Förståelig – är informationen enkel att använda, lära sig, ändra? Går den att sätta ihop och kombinera med annan information?
- Vad tror du att rework beror på? Behöver ni konstruera om produkter?
- Vilken prioritetsordning jobbar du efter? Vilket projekt/vilken arbetsuppgift kommer i första hand?

Appendix III

Interviews at OEG

Title	Division	Date	Time (h)	Interview type
Sub-project Manager	PL	9/2-012	1	Semi-structured
Manager	PE	13/2-2012	1	Semi-structured
Sub-project Manager	SP	14/2-2012	1	Semi-structured
Project Manager	BR	17/2-2012	1	Semi-structured
Product Planner	SP	28/2-2012	1	Semi-structured
Sub-system Ressponsible	PE	1/3-2012	1	Semi-structured
Design Engineer	PK	2/3-2012	1	Semi-structured
Platform Design Engineer	PE	2/3-2012	1	Semi-structured
System Designer	DG	2/3-2012	1	Semi-structured
Sub-project Manager	PL	20/3-2012	0,5	Semi-structured
Sub-project Manager	DI	28/3-2012	0,5	Semi-structured
System Designer	DG	28/3-2012	1	Semi-structured
Purchaser	SI	28/3-2012	0,5	Semi-structured
Sub-project Manager	DI	11/4-2012	0,5	Semi-structured
Configuration manager	DO	16/4-2012	0,5	Semi-structured
Tester	SP	16/4-2012	0,5	Semi-structured
Design Engineer	PU	20/4-2012	e-mail	Structured

Interviews with Experts

	Title	Organisation	Date	Time (h)	Interview type
Expert 1	Senior University Lecturer & Researcher	Logistics and Transportation, Chalmers University of Technology	16/2-2012	1	Semi-structured
Expert 2	PhD	Operations Management, Chalmers University of Technology	15/2-2012	1	Un-structured
Expert 3	Professor	Mechanical & Industrial Engineering Dept., Montana State University	9/3-2012	1	Un-structured
Expert 4	PhD	Operations Management, Chalmers University of Technology	19/3-2012	1	Un-structured

Study Visits

Name	Title	Organisation	Date	Time (h)	Interview type
Per Malmborg	Operations Development & Lean manager	RUAG Space AB	29/2-2012	1	Un-structured
Daniel Lundgren	Manager Quality Management	Ericsson AB	19/4-2012	3	Study visit

Appendix IV

Information Sharing between PE and the Other Divisions at OEG

Ditt namn (frivilligt)

Hur länge har du arbetat på Saab?

Mindre än ett år 1-5 år 5-10 år 10-20 år Mer än 20 år

Vad är dina huvudsakliga arbetsuppgifter?

Konstruktion enheter Konstruktion installation Konstruktionsstöd Delsystemarbete

Verifiering/analyser Annat

Vid annat, vänligen specificera

Information från PK (Kraft & Kablage)

Får du information från Kraft & Kablage?

Ja

Nej

Vad berör oftast den information som du får från Kraft & Kablage?

EEH-ärenden Enkla och små omkonstruktioner Gränssnitt Nykonstruktion Annat

Vid annat, vänligen specificera.

På vilket sätt får du information från Kraft & Kablage?

Mail Telefonsamtal Möten Spontant när vi träffas i korridorerna DPL

Jag går och frågar/personen kommer till mig Annat

Vid annat, vänligen specificera.

Hur ofta får du information från Kraft & Kablage? Vänligen kryssa i det alternativ som passar bäst in på ditt arbete.

☐ Varje dag ☐ Några gånger i veckan ☐ Några gånger i månaden ☐ Några gånger per år

Informationen som jag får från Kraft & Kablage... Vänligen fyll i det alternativ som passar bäst in.

	Nej, aldrig	Ibland	För det mesta	Alltid
...går att förstå eftersom den är i rätt språk, format och upplägg.	○	○	○	○
...går att förstå eftersom den innehåller rätt och fullständig information.	○	○	○	○
...kommer i lagom tid, precis när jag behöver den.	○	○	○	○
...kommer för tidigt.	○	○	○	○
...kommer för sent.	○	○	○	○
...innehåller för lite information så att jag måste söka mer information.	○	○	○	○
...innehåller för mycket information så att jag måste sortera ut det som jag behöver.	○	○	○	○

Information från PU (Microwave, Antenn & Laser)

Får du information från Microwave, Antenn & Laser?

○ Ja

○ Nej

Vad berör oftast den information som du får från Microwave, Antenn & Laser?

☐ EEH-ärenden ☐ Enkla och små omkonstruktioner ☐ Gränssnitt ☐ Nykonstruktion ☐ Annat

Vid annat, vänligen specificera.

På vilket sätt får du information från Microwave, Antenn & Laser?

☐ Mail ☐ Telefonsamtal ☐ Möten ☐ Spontant när vi träffas i korridorerna

☐ Jag går och frågar/personen kommer till mig ☐ DPL ☐ Annat

Vid annat, vänligen specificera.

Hur ofta får du information från Microwave, Antenn & Laser? Vänligen kryssa i de alternativ som passar bäst in på ditt arbete.

☐ Varje dag ☐ Några gånger i veckan ☐ Några gånger i månaden ☐ Några gånger per år

Informationen som jag får från Microwave, Antenn & Laser... Vänligen fyll i det alternativ som passar bäst in.

	Nej, aldrig	Ibland	För det mesta	Alltid
...går att förstå eftersom den är i rätt språk, format och upplägg.	○	○	○	○
...går att förstå eftersom den innehåller rätt och fullständig information.	○	○	○	○
...kommer i lagom tid, precis när jag behöver den.	○	○	○	○
...kommer för tidigt.	○	○	○	○
...kommer för sent.	○	○	○	○
...innehåller för lite information så att jag måste söka mer information.	○	○	○	○
...innehåller för mycket information så att jag måste sortera ut det som jag behöver.	○	○	○	○

Information från DG (System Office)

Får du information från System Office?

Ja

Nej

Vad berör oftast den information som du får från System Office?

EEH-ärenden Omkonstruktioner Kravspecar Nykonstruktion Annat

Vid annat, vänligen specificera

På vilket sätt får du information från System Office?

Mail Telefonsamtal Möten Spontant när vi träffas i korridorerna

Jag går och frågar/personen kommer till mig DPL Annat

Vid annat, vänligen specificera

Hur ofta får du information från System Office? Vänligen kryssa i de alternativ som passar bäst in på ditt arbete.

Varje dag Några gånger i veckan Några gånger i månaden Några gånger per år

Informationen som jag får från System Office... Vänligen fyll i det alternativ som passar bäst in.

	Nej, aldrig	Ibland	För det mesta	Alltid
...går att förstå eftersom den är i rätt språk, format och upplägg.				
...går att förstå eftersom den innehåller rätt och fullständig information.				
...kommer i lagom tid, precis när jag behöver den.				

...kommer för tidigt.	○	○	○	○
...kommer för sent.	○	○	○	○
...innehåller för lite information så att jag måste söka mer information.	○	○	○	○
...innehåller för mycket information så att jag måste sortera ut det som jag behöver.	○	○	○	○

Information från DI (ILS och System Safety)

Får du information från ILS & System Safety?

○ Ja

○ Nej

Vad berör oftast den information som du får från ILS & System Safety?

☐ EEH-ärenden ☐ Enkla och små omkonstruktioner ☐ Kravspecar ☐ Konstruktionsspecar

☐ Annat

Vid annat, vänligen specificera

På vilket sätt får du information från ILS & System Safety?

☐ Mail ☐ Telefonsamtal ☐ Möten ☐ Spontant när vi träffas i korridorerna

☐ Jag går och frågar/personen kommer till mig ☐ DPL ☐ Annat

Vid annat, vänligen specificera.

Hur ofta får du information från ILS & System Safety? Vänligen kryssa i de alternativ som passar bäst in på ditt arbete.

☐ Varje dag ☐ Några gånger i veckan ☐ Några gånger i månaden ☐ Några gånger per år

Informationen som jag får från ILS & System Safety... Vänligen fyll i det alternativ som passar bäst in.

	Nej, aldrig	Ibland	För det mesta	Alltid
...går att förstå efterom den är i rätt språk, format och upplägg.	○	○	○	○
...går att förstå eftersom den innehåller rätt och fullständig information.	○	○	○	○
...innehåller för lite information så att jag måste söka mer information.	○	○	○	○
...innehåller för mycket information så att jag måste sortera ut det som jag behöver.	○	○	○	○

Information från SI (Inköp)

Får du information från inköp?

○ Ja

○ Nej

Vad berör oftast den information som du får från inköp?

☐ EEH-ärenden ☐ Förfrågningar om enkla och små omkonstruktioner ☐ Nykonstruktion ☐ Annat

Vid annat, vänligen specificera.

På vilket sätt får du information från inköp?

☐ Mail ☐ Telefonsamtal ☐ Möten ☐ Spontant när vi träffas i korridorerna

☐ Jag går och frågar/personen kommer till mig ☐ DPL ☐ Annat

Vid annat, vänligen specificera.

Hur ofta får du information från inköp? Vänligen kryssa i de alternativ som passar bäst in på ditt arbete.

☐ Varje dag ☐ Några gånger i veckan ☐ Några gånger i månaden ☐ Några gånger per år

Informationen som jag får från inköp.. Vänligen fyll i det alternativ som passar bäst in.

	Nej, aldrig	Ibland	För det mesta	Alltid
...innehåller tidig och lättförstådd information.	○	○	○	○
...innehåller rätt och fullständig information.	○	○	○	○
...innehåller för lite information så att jag måste söka mer information.	○	○	○	○
...innehåller för mycket information så att jag måste sortera ut det som jag behöver.	○	○	○	○

Information från SP (Produktion)

Får du information från produktion?

○ Ja

○ Nej

Vad berör oftast den information som du får från produktion?

☐ EEH-ärenden ☐ Enkla och små omkonstruktioner ☐ Stora omkonstruktioner. ☐ Nykonstruktion ☐ Annat

Vid annat, vänligen specificera.

På vilket sätt får du information från produktion?

☐ Mail ☐ Telefonsamtal ☐ Möten ☐ Spontant när vi träffas i korridorerna ☐ DPL ☐ Annat

Vid annat, vänligen specificera.

Hur ofta får du information från produktion? Vänligen kryssa i de alternativ som passar bäst in på ditt arbete.

☐ Varje dag ☐ Några gånger i veckan ☐ Några gånger i månaden ☐ Några gånger per år

Informationen som jag får från produktion.. Vänligen fyll i det alternativ som passar bäst in.

	Nej, aldrig	Ibland	För det mesta	Alltid
...går att förstå efterom den är i rätt språk, format och upplägg.	○	○	○	○
...går att förstå eftersom den innehåller rätt och fullständig information.	○	○	○	○
...innehåller för lite information så att jag måste söka mer information.	○	○	○	○
...innehåller för mycket inforamtion så att jag måste sortera ut den information som jag behöver.	○	○	○	○

Information från din DPL

Får du information från din DPL?

○ Ja

○ Nej

Vad berör oftast den information som du får från din DPL?

☐ EEH-ärenden ☐ Omkonstruktioner ☐ Kravspecar ☐ Konstruktionsspecar ☐ Nykonstruktion ☐ Annat

Vid annat, vänligen specificera.

På vilket sätt får du information från din DPL?

☐ Mail ☐ Telefonsamtal ☐ Möten ☐ Spontant när vi träffas i korridorerna ☐ Annat

Vid annat, vänligen specificera

Hur ofta får du information från din DPL? Vänligen kryssa i de alternativ som passar bäst in på ditt arbete.

☐ Varje dag ☐ Några gånger i veckan ☐ Några gånger i månaden ☐ Några gånger per år

Informationen som jag får från min DPL.. Vänligen fyll i det alternativ som passar bäst in.

	Nej, aldrig	Ibland	För det mesta	Alltid
...går att förstå efterom den är i rätt språk, format och upplägg.	○	○	○	○
...går att förstå eftersom den innehåller rätt och fullständig information.	○	○	○	○
...kommer i lagom tid, precis när jag behöver den.	○	○	○	○
...kommer för tidigt.	○	○	○	○
...kommer för sent.	○	○	○	○
...innehåller för lite information så att jag måste söka mer information.	○	○	○	○
...innehåller för mycket information så att jag måste sortera ut den informationen som jag behöver.	○	○	○	○

Informationsbärare

Betygsätt följande informationsbärare med avseende på hur bra de är på att förse dig med den information som är rätt för dig. Väl det alternativ som passar bäst.

	Mycket bra	Bra	Sådär	Dålig	Använder ej informationsbäraren
IFS	○	○	○	○	○
DPL	○	○	○	○	○
PRI	○	○	○	○	○
Möten	○	○	○	○	○

Konstruktionsspec	○	○	○	○	○
Kravspec	○	○	○	○	○

Vilka är din interna kunder, dvs. vilka behöver information från dig?

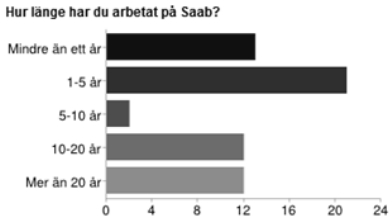
☐ PK (Kraft & Kablage) ☐ PU (Microwave, Antenn & Laser) ☐ DPL ☐ SI (Inköp) ☐ SP (Produktion)

☐ DG (System Office) ☐ DI (ILS & System Safety)

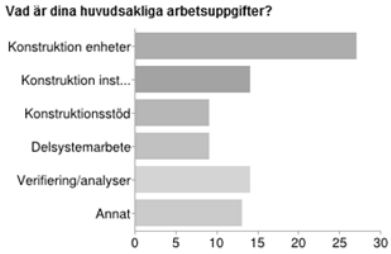
Vilken typ av information förser du din internkund med?

Appendix V

In line with Lean and the visibility aspect, the results are shown in graphs instead of pure data.



Mindre än ett år	13	21%
1-5 år	21	34%
5-10 år	2	3%
10-20 år	12	20%
Mer än 20 år	12	20%



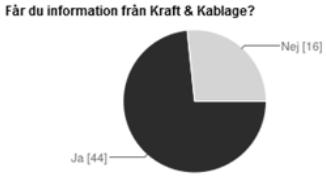
Konstruktion enheter	27	45%
Konstruktion installation	14	23%
Konstruktionsstöd	9	15%
Delsystemarbete	9	15%
Verifiering/analyser	14	23%
Annat	13	22%

People may select more than one checkbox, so percentages may add up to more than 100%.

Vid annat, vänligen specificera

- External Provisioning. (underkontraktering av komplexa delsytem) - Reservdelshantering - Metoder och processer. - Configurationsteknik - Lokal applikationsansvarig för IFS och EEH - Chef över material och beräkningssektionen - Chef för mekanikavdelningen - Specialist inom elektronikbyggsätt - Jobbar med standardisering av byggsätt, strategiarbete inom detta område - Till största delenen med konstruktionsstöd inom detta område – Strukturarbete - Byggsättsansvarig för SDU'er och TRU'er - Delsystemansvarig mekanik för ett mobilt radarsystem - Tekniskt ansvarig vid inköp av stödsystem - Chef för verification & Sevicve.

Information från PK (Kraft & Kablage)



Ja	44	72%
Nej	16	26%

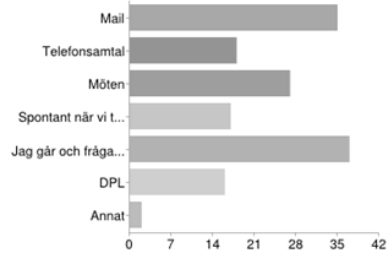
Vid annat, vänligen specificera.

EEH-ärenden	11	25%
Enkla och små omkonstruktioner	14	32%
Gränssnitt	20	45%
Nykonstruktion	27	61%
Annat	8	18%

People may select more than one checkbox, so percentages may add up to more than 100%.

Ingen speciell information direkt från OEGPK - Verifiering av enheter - Gränssnitt mellan enheter i projekt och organisation - Tolkar gränsnitt ovan som tekniska gränssnittsspecar - De flesta enheter som jag är med och konstruerar är ett samarbete mellan oss. Man ger och tar mot information hela tiden och arbetar som ett team - Veckovis informell avstämning med chefen för OEGPKS - Kabellistor och kabelmontageritningar till kunddokument bl.a. - Behov av verifiering - External provisioning info.

På vilket sätt får du information från Kraft & Kablage?



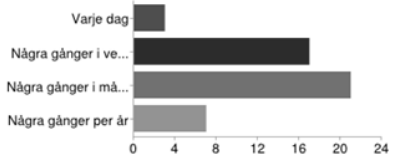
Mail	35	80%
Telefonsamtal	18	41%
Möten	27	61%
Spontant när vi träffas i korridorerna	17	39%
Jag går och frågar/personen kommer till mig	37	84%
DPL	16	36%
Annat	2	5%

People may select more than one checkbox, so percentages may add up to more than 100%.

Vid annat, vänligen specificera.

Via IFS om vilka produkter som skall användas- Det kan komma uppdrag och då går det via linjechefen, innan det hamnar på mitt bord.

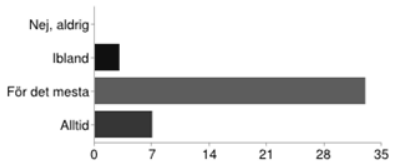
Hur ofta får du information från Kraft & Kablage?



Varje dag	3	7%
Några gånger i veckan	17	39%
Några gånger i månaden	21	48%
Några gånger per år	7	16%

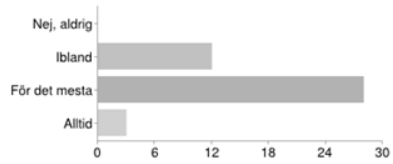
People may select more than one checkbox, so percentages may add up to more than 100%.

Informationen som jag får från Kraft & Kablage... - ...går att förstå eftersom den är i rätt språk, format och upplägg.



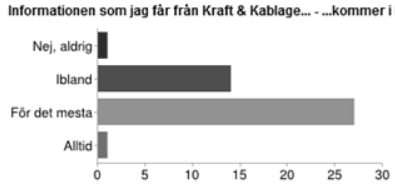
Nej, aldrig	0	0%
Ibland	3	5%
För det mesta	33	54%
Alltid	7	11%

Informationen som jag får från Kraft & Kablage... - ...går att förstå eftersom den innehåller rätt och fullständig information.



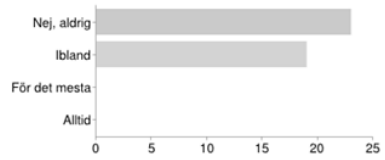
Nej, aldrig	0	0%
Ibland	12	20%
För det mesta	28	46%
Alltid	3	5%

Informationen som jag får från Kraft & Kablage... - ...kommer i lagom tid, precis när jag behöver den.



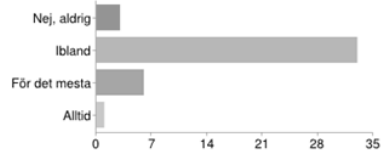
Nej, aldrig	1	2%
Ibland	14	23%
För det mesta	27	44%
Alltid	1	2%

Informationen som jag får från Kraft & Kablage... - ...kommer för tidigt.



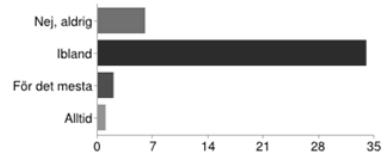
Nej, aldrig	23	38%
Ibland	19	31%
För det mesta	0	0%
Alltid	0	0%

Informationen som jag får från Kraft & Kablage... - ...kommer för sent.



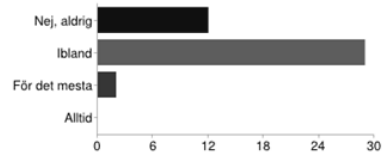
Nej, aldrig	3	5%
Ibland	33	54%
För det mesta	6	10%
Alltid	1	2%

Informationen som jag får från Kraft & Kablage... - ...innehåller för lite information så att jag måste söka mer information.



Nej, aldrig	6	10%
Ibland	34	56%
För det mesta	2	3%
Alltid	1	2%

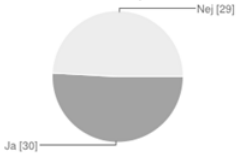
Informationen som jag får från Kraft & Kablage... - ...innehåller för mycket information så att jag måste sortera ut det som jag behöver.



Nej, aldrig	12	20%
Ibland	29	48%
För det mesta	2	3%
Alltid	0	0%

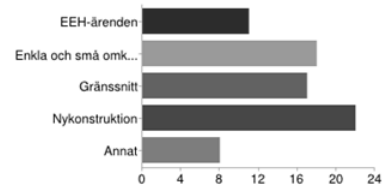
Information från PU (Microwave, Antenn & Laser)

Får du information från Microwave, Antenn & Laser?



Ja	30	49%
Nej	29	48%

Vad berör oftast den information som du får från Microwave, Antenn & Laser?



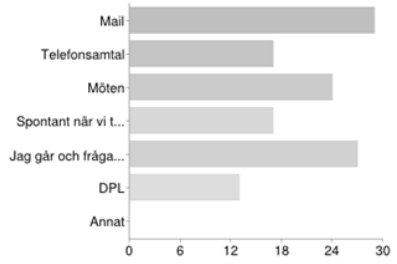
EEH-ärenden	11	35%
Enkla och små omkonstruktioner	18	58%
Gränssnitt	17	55%
Nykonstruktion	22	71%
Annat	8	26%

People may select more than one checkbox, so percentages may add up to more than 100%.

Vid annat, vänligen specificera.

Vid granskningar av dokument som är metodrelaterade - Underlag för förändringar i IFS/PDMStrategifrågor, ansvarsroller - Gränssnitt i projekt och mellan organisationer - Reparationer/Haverier - Behov av verifiering eller provning - Felutfall i konstruktioner under PU:s konstruktionsansvar - Allmän information om vad som händer i de olika projekten.

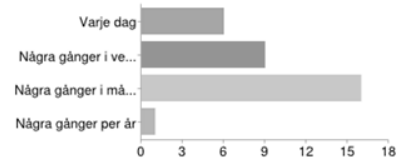
På vilket sätt får du information från Microwave, Antenn & Laser?



Mail	**29**	94%
Telefonsamtal	**17**	55%
Möten	**24**	77%
Spontant när vi träffas i korridorerna	**17**	55%
Jag går och frågar/personen kommer till mig	**27**	87%
DPL	**13**	42%
Annat	**0**	0%

People may select more than one checkbox, so percentages may add up to more than 100%.

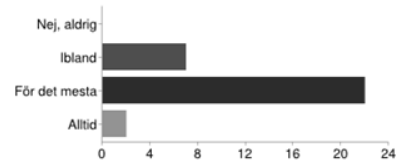
Hur ofta får du information från Microwave, Antenn & Laser?



Varje dag	**6**	19%
Några gånger i veckan	**9**	29%
Några gånger i månaden	**16**	52%
Några gånger per år	**1**	3%

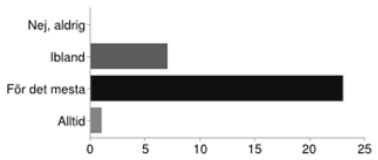
People may select more than one checkbox, so percentages may add up to more than 100%.

Informationen som jag får från Microwave, Antenn & Laser... - ...går att förstå eftersom den är i rätt språk, format och upplägg.



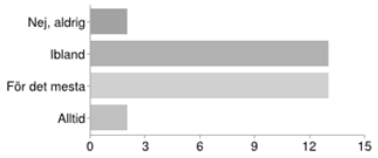
Nej, aldrig	**0**	0%
Ibland	**7**	11%
För det mesta	**22**	36%
Alltid	**2**	3%

Informationen som jag får från Microwave, Antenn & Laser... - ...går att förstå eftersom den innehåller rätt och fullständig information.



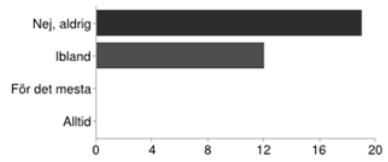
Nej, aldrig	**0**	0%
Ibland	**7**	11%
För det mesta	**23**	38%
Alltid	**1**	2%

Informationen som jag får från Microwave, Antenn & Laser... - ...kommer i lagom tid, precis när jag behöver den.



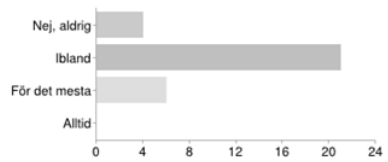
Nej, aldrig	**2**	3%
Ibland	**13**	21%
För det mesta	**13**	21%
Alltid	**2**	3%

Informationen som jag får från Microwave, Antenn & Laser... - ...kommer för tidigt.



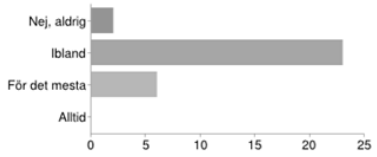
Nej, aldrig	19	31%
Ibland	12	20%
För det mesta	0	0%
Alltid	0	0%

Informationen som jag får från Microwave, Antenn & Laser... - ...kommer för sent.



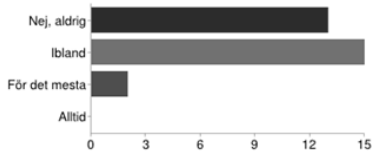
Nej, aldrig	4	7%
Ibland	21	34%
För det mesta	6	10%
Alltid	0	0%

Informationen som jag får från Microwave, Antenn & Laser... - ...innehåller för lite information så att jag måste söka mer information.



Nej, aldrig	2	3%
Ibland	23	38%
För det mesta	6	10%
Alltid	0	0%

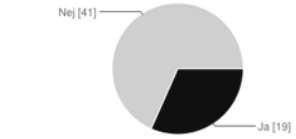
Informationen som jag får från Microwave, Antenn & Laser... - ...innehåller för mycket information så att jag måste sortera ut det som jag behöver.



Nej, aldrig	13	21%
Ibland	15	25%
För det mesta	2	3%
Alltid	0	0%

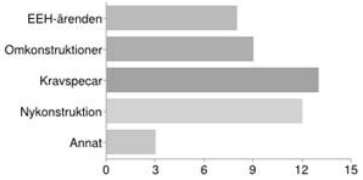
Information från DG (System Office)

Får du information från System Office?



Ja	19	31%
Nej	41	67%

Vad berör oftast den information som du får från System Office?



EEH-ärenden	8	42%
Omkonstruktioner	9	47%
Kravspecar	13	68%
Nykonstruktion	12	63%
Annat	3	16%

People may select more than one checkbox, so percentages may add up to more than 100%.

Vid annat, vänligen specificera.

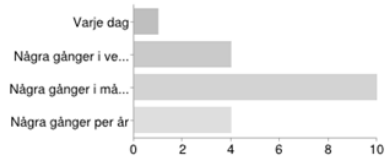
Layouter - Gränsnsitt i projekt och mellan organisationerverifieringsärenden.

På vilket sätt får du information från System Office?

Mail	**15**	79%
Telefonsamtal	**10**	53%
Möten	**17**	89%
Spontant när vi träffas i korridorerna	**7**	37%
Jag går och frågar/personen kommer till mig	**8**	42%
DPL	**9**	47%
Annat	**0**	0%

People may select more than one checkbox, so percentages may add up to more than 100%.

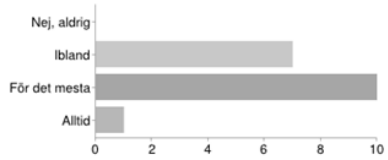
Hur ofta får du information från System Office?



Varje dag	**1**	5%
Några gånger i veckan	**4**	21%
Några gånger i månaden	**10**	53%
Några gånger per år	**4**	21%

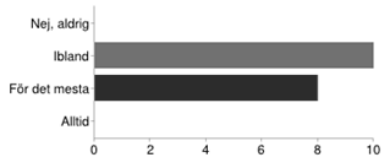
People may select more than one checkbox, so percentages may add up to more than 100%.

Informationen som jag får från System Office... - ...går att förstå eftersom den är i rätt språk, format och upplägg.



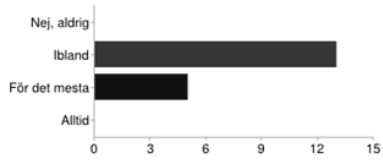
Nej, aldrig	**0**	0%
Ibland	**7**	11%
För det mesta	**10**	16%
Alltid	**1**	2%

Informationen som jag får från System Office... - ...går att förstå eftersom den innehåller rätt och fullständig information.



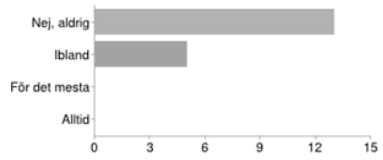
Nej, aldrig	**0**	0%
Ibland	**10**	16%
För det mesta	**8**	13%
Alltid	**0**	0%

Informationen som jag får från System Office... - ...kommer i lagom tid, precis när jag behöver den.



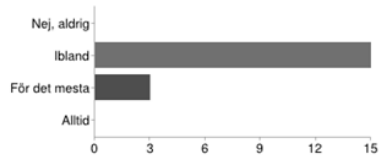
Nej, aldrig	**0**	0%
Ibland	**13**	21%
För det mesta	**5**	8%
Alltid	**0**	0%

Informationen som jag får från System Office... - ...kommer för tidigt.



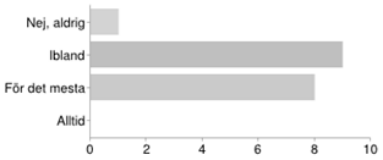
Nej, aldrig	13	21%
Ibland	5	8%
För det mesta	0	0%
Alltid	0	0%

Informationen som jag får från System Office... - ...kommer för sent.



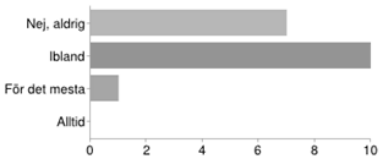
Nej, aldrig	0	0%
Ibland	15	25%
För det mesta	3	5%
Alltid	0	0%

Informationen som jag får från System Office... - ...innehåller för lite information så att jag måste söka mer information.



Nej, aldrig	1	2%
Ibland	9	15%
För det mesta	8	13%
Alltid	0	0%

Informationen som jag får från System Office... - ...innehåller för mycket information så att jag måste sortera ut det som jag behöver.



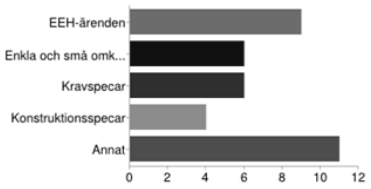
Nej, aldrig	7	11%
Ibland	10	16%
För det mesta	1	2%
Alltid	0	0%

Information från DI (ILS och System Safety)

Får du information från ILS & System Safety?

Ja	21	34%
Nej	39	64%

Vad berör oftast den information som du får från ILS & System Safety?



EEH-ärenden	9	43%
Enkla och små omkonstruktioner	6	29%
Kravspecar	6	29%
Konstruktionsspecar	4	19%
Annat	11	52%

People may select more than one checkbox, so percentages may add up to more than 100%.

Vid annat, vänligen specificera.

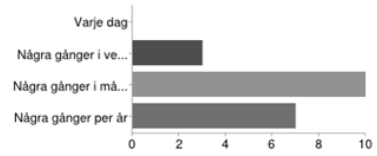
Information angående produktförändringar så som nya förändrade reservdelar. Informationen kommer via teknikansvariga på OEGPE - Utredning angående olkarheter i ex kundmanualer och reservdelsllistor - Utbildningsärenden och System Safety BoardInstallationsfrågor, Reservdelar, Manualer, osv - Arbetsmöten med en eller två personer framför dator - Önskemål om hjälp med dokumentataion och kurser - Mock-up bygge samt utbildare - Installationsmanualer, kunddokumentation - Dom skall medverka både vid kravspecificering, konstruktion/tillverkningfas och efter leverans – Samarbete, process och metodfrågor om reservdelar.

På vilket sätt får du information från ILS & System Safety?

Mail	**17**	81%
Telefonsamtal	**11**	52%
Möten	**15**	71%
Spontant när vi träffas i korridorerna	**5**	24%
Jag går och frågar/personen kommer till mig	**8**	38%
DPL	**7**	33%
Annat	**0**	0%

People may select more than one checkbox, so percentages may add up to more than 100%.

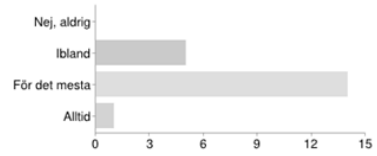
Hur ofta får du information från ILS & System Safety?



Varje dag	**0**	0%
Några gånger i veckan	**3**	15%
Några gånger i månaden	**10**	50%
Några gånger per år	**7**	35%

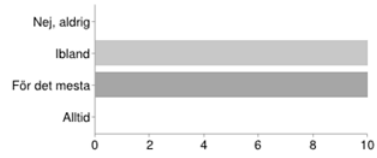
People may select more than one checkbox, so percentages may add up to more than 100%.

Informationen som jag får från ILS & System Safety... - ...går att förstå efterom den är i rätt språk, format och upplägg.



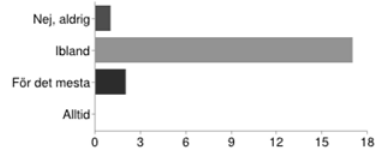
Nej, aldrig	**0**	0%
Ibland	**5**	8%
För det mesta	**14**	23%
Alltid	**1**	2%

Informationen som jag får från ILS & System Safety... - ...går att förstå eftersom den innehåller rätt och fullständig information.



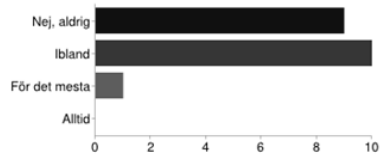
Nej, aldrig	**0**	0%
Ibland	**10**	16%
För det mesta	**10**	16%
Alltid	**0**	0%

Informationen som jag får från ILS & System Safety... - ...innehåller för lite information så att jag måste söka mer information.



Nej, aldrig	**1**	2%
Ibland	**17**	28%
För det mesta	**2**	3%
Alltid	**0**	0%

Informationen som jag får från ILS & System Safety... - ...innehåller för mycket information så att jag måste sortera ut det som jag behöver.



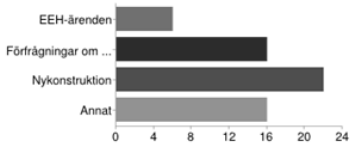
Nej, aldrig	**9**	15%
Ibland	**10**	16%
För det mesta	**1**	2%
Alltid	**0**	0%

Information från SI (Inköp)

Får du information från inköp?

Ja	37	61%
Nej	23	38%

Vad berör oftast den information som du får från inköp?



EEH-ärenden	6	17%
Förfrågningar om enkla och små omkonstruktioner	16	44%
Nykonstruktion	22	61%
Annat	16	44%

People may select more than one checkbox, so percentages may add up to more than 100%.

Vid annat, vänligen specificera.

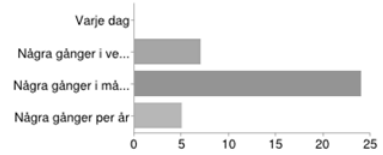
Behandling av inköpsärenden i form av inköpsanmodan om komponenter för prototypkonstruktion - Ibland är det inköp som söker information från mig - När det saknas underlag för ett korrekt inköp. - Dokumentation - Gränssnitt i projekt och mellan organisationer - Garantiärenden, Kravspecifikationer för strategiska inköp, osv - Jag går till dem med vid behov, tex inköp av komponenter till produktionsutrustningar.- Beställningar direkt från leverantörer. - Problem med tillverkningsunderlagen - Frågor från leverantörer - Inköp av reservdelar. - Inköpsfrågor angående pågående inköp som jag är inblandad i. - Inköp är en viktig medverkande part i vårt arbete med underleverantörer och medverkar i hela kontraktsfasen från val av leverantör till efter leverans - Felutfall på inköpta produkter - Material som leverantör inte får tag i. - Problem med Leverantörers tekniska kunskap i dataöverföring. - Felaktig eller saknad dokumentation.- Leveranser av reservdelar, leveranser av information om underkontrakterade enheter, frågor till underleverantörer ang. fel på produkter - Information angående utlägg av tillverkning alt. inköp av art.- I samband med slutköpsärenden.

På vilket sätt får du information från inköp?

Mail	36	97%
Telefonsamtal	27	73%
Möten	22	59%
Spontant när vi träffas i korridorerna	10	27%
Jag går och frågar/personen kommer till mig	21	57%
DPL	8	22%
Annat	0	0%

People may select more than one checkbox, so percentages may add up to more than 100%.

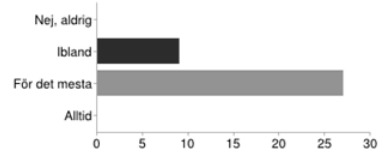
Hur ofta får du information från inköp?



Varje dag	0	0%
Några gånger i veckan	7	19%
Några gånger i månaden	24	67%
Några gånger per år	5	14%

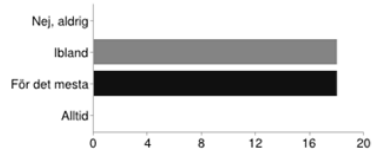
People may select more than one checkbox, so percentages may add up to more than 100%.

Informationen som jag får från inköp.. - ...innehåller tidlig och lättförstådd information.



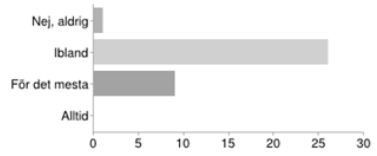
Nej, aldrig	0	0%
Ibland	9	15%
För det mesta	27	44%
Alltid	0	0%

Informationen som jag får från inköp.. - ...innehåller rätt och fullständig information.



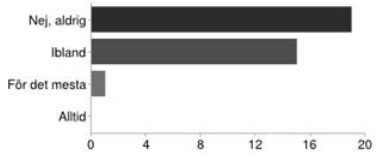
Nej, aldrig	0	0%
Ibland	18	30%
För det mesta	18	30%
Alltid	0	0%

Informationen som jag får från inköp.. - ...innehåller för lite information så att jag måste söka mer information.



Nej, aldrig	1	2%
Ibland	26	43%
För det mesta	9	15%
Alltid	0	0%

Informationen som jag får från inköp.. - ...innehåller för mycket information så att jag måste sortera ut det som jag behöver.



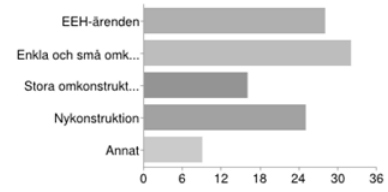
Nej, aldrig	19	31%
Ibland	15	25%
För det mesta	1	2%
Alltid	0	0%

Information från SP (Produktion)

Får du information från produktion?

Ja	45	74%
Nej	15	25%

Vad berör oftast den information som du får från produktion?



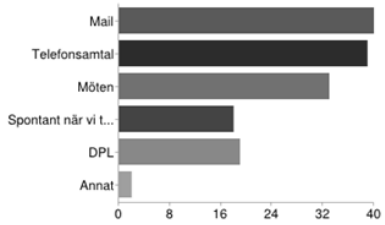
EEH-ärenden	28	62%
Enkla och små omkonstruktioner	32	71%
Stora omkonstruktioner.	16	36%
Nykonstruktion	25	56%
Annat	9	20%

People may select more than one checkbox, so percentages may add up to more than 100%.

Vid annat, vänligen specificera.

Byggsättsstandardisering av kablagefastsättning - Gränssnitt i projekt och mellan organisationer - Reparationer/Haverier - Jag har till största delen haft kontakt med OEGSPV - Tar ofta hjälp när det gäller att åtgärda fel rent fysiskt. - Frågar ofta för att få deras erfarenhet av hur saker fungerar. - Installation och uppstart av delsystem (vridbord) - I samband med slutköpsärenden. - Exempelvis hjälp med hanteringstester och verifiering.

På vilket sätt får du information från produktion?



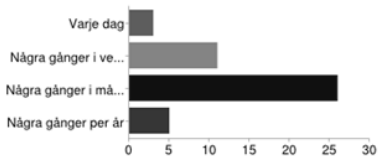
Mail	40	89%
Telefonsamtal	39	87%
Möten	33	73%
Spontant när vi träffas i korridorerna	18	40%
DPL	19	42%
Annat	2	4%

People may select more than one checkbox, so percentages may add up to more than 100%.

Vid annat, vänligen specificera.

Väldigt blandat, svårt att peka ut något. - Går och pratar med personen i fråga när jag behöver info/hjälp.

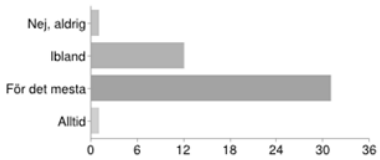
Hur ofta får du information från produktion?



Varje dag	3	7%
Några gånger i veckan	11	25%
Några gånger i månaden	26	59%
Några gånger per år	5	11%

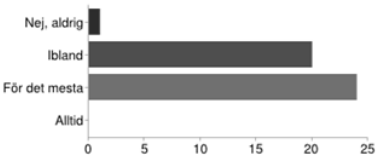
People may select more than one checkbox, so percentages may add up to more than 100%.

Informationen som jag får från produktion.. - ...går att förstå efterom den är i rätt språk, format och upplägg.



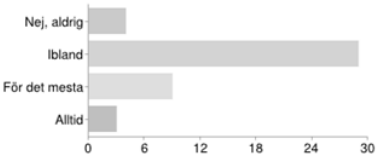
Nej, aldrig	1	2%
Ibland	12	20%
För det mesta	31	51%
Alltid	1	2%

Informationen som jag får från produktion.. - ...går att förstå eftersom den innehåller rätt och fullständig information.



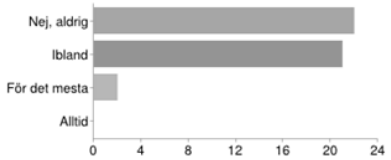
Nej, aldrig	1	2%
Ibland	20	33%
För det mesta	24	39%
Alltid	0	0%

Informationen som jag får från produktion.. - ...innehåller för lite information så att jag måste söka mer information.



Nej, aldrig	4	7%
Ibland	29	48%
För det mesta	9	15%
Alltid	3	5%

Informationen som jag får från produktion.. - ...innehåller för mycket inforamtion så att jag måste sortera ut den information som jag behöver.



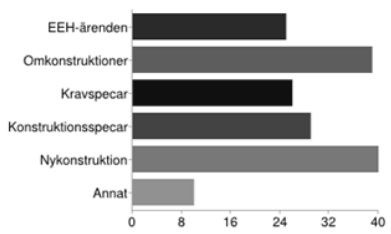
Nej, aldrig	22	36%
Ibland	21	34%
För det mesta	2	3%
Alltid	0	0%

Information från din DPL

Får du information från din DPL?

Ja	54	89%
Nej	6	10%

Vad berör oftast den information som du får från din DPL?



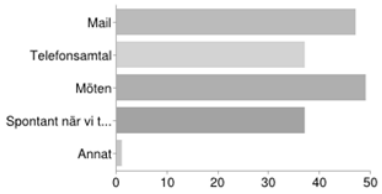
EEH-ärenden	25	46%
Omkonstruktioner	39	72%
Kravspecar	26	48%
Konstruktionsspecar	29	54%
Nykonstruktion	40	74%
Annat	10	19%

People may select more than one checkbox, so percentages may add up to more than 100%.

Vid annat, vänligen specificera.

Underlag för att speca in nya externa produkter.- Allmän projektinformation, tidplaner etc. - Ekonomi, progress och tidshållning - Jobbar mot många dpl samtidigt så det kan variera lite mellan de olika personerna - Reparationer/Haverier - Har endast jobbat i ett projekt där jag haft kontakt med projektledare. - Verifieringspunkter, leveransstatus på delar man är inblandad i – Provningsföreskrifter - Tidsplan, Övergripande info, Enstaka specifika konstruktionsärenden. - Allmän information om projekten.

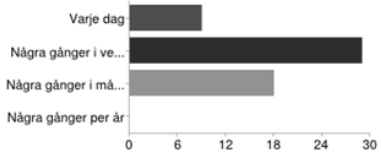
På vilket sätt får du information från din DPL?



Mail	47	87%
Telefonsamtal	37	69%
Möten	49	91%
Spontant när vi träffas i korridorerna	37	69%
Annat	1	2%

People may select more than one checkbox, so percentages may add up to more than 100%.

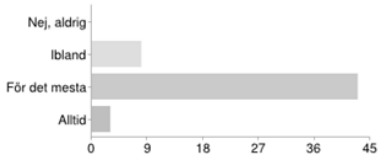
Hur ofta får du information från din DPL?



Varje dag	9	17%
Några gånger i veckan	29	55%
Några gånger i månaden	18	34%
Några gånger per år	0	0%

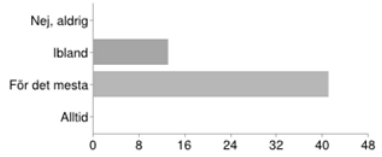
People may select more than one checkbox, so percentages may add up to more than 100%.

Informationen som jag får från min DPL.. - ...går att förstå efterom den är i rätt språk, format och upplägg.



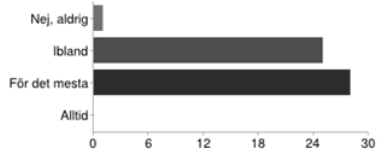
Nej, aldrig	0	0%
Ibland	8	13%
För det mesta	43	70%
Alltid	3	5%

Informationen som jag får från min DPL.. - ...går att förstå eftersom den innehåller rätt och fullständig information.



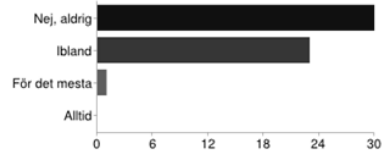
Nej, aldrig	0	0%
Ibland	13	21%
För det mesta	41	67%
Alltid	0	0%

Informationen som jag får från min DPL.. - ...kommer i lagom tid, precis när jag behöver den.



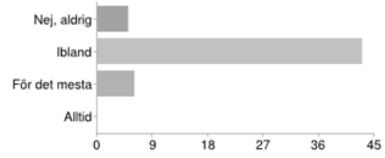
Nej, aldrig	1	2%
Ibland	25	41%
För det mesta	28	46%
Alltid	0	0%

Informationen som jag får från min DPL.. - ...kommer för tidigt.



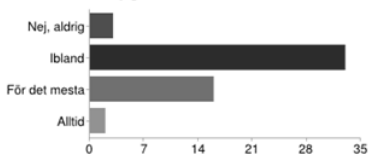
Nej, aldrig	30	49%
Ibland	23	38%
För det mesta	1	2%
Alltid	0	0%

Informationen som jag får från min DPL.. - ...kommer för sent.



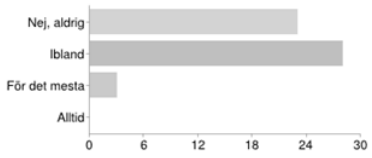
Nej, aldrig	5	8%
Ibland	43	70%
För det mesta	6	10%
Alltid	0	0%

Informationen som jag får från min DPL.. - ...innehåller för lite information så att jag måste söka mer information.



Nej, aldrig	3	5%
Ibland	33	54%
För det mesta	16	26%
Alltid	2	3%

Informationen som jag får från min DPL.. - ...innehåller för mycket information så att jag måste sortera ut den informationen som jag behöver.



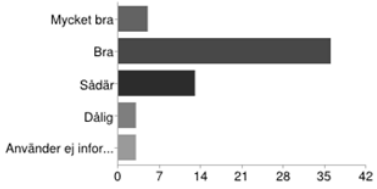
Nej, aldrig	23	38%
Ibland	28	46%
För det mesta	3	5%
Alltid	0	0%

Informationsbärare

Betygsätt följande informationsbärare med avseende på hur bra de är på att förse dig med den information som är rätt för dig. - IFS

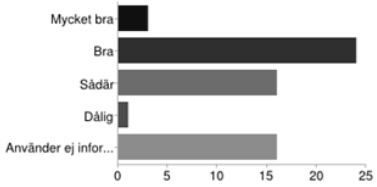
Mycket bra	10	16%
Bra	37	61%
Sådär	5	8%
Dålig	4	7%
Använder ej informationsbäraren	3	5%

Betygsätt följande informationsbärare med avseende på hur bra de är på att förse dig med den information som är rätt för dig. - DPL



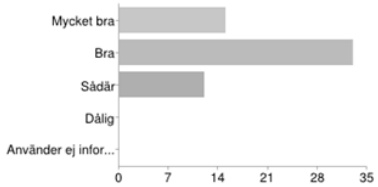
Mycket bra	5	8%
Bra	36	59%
Sådär	13	21%
Dålig	3	5%
Använder ej informationsbäraren	3	5%

Betygsätt följande informationsbärare med avseende på hur bra de är på att förse dig med den information som är rätt för dig. - PRI



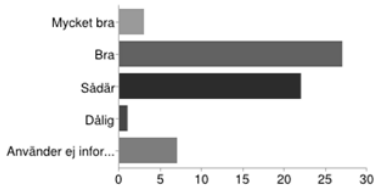
Mycket bra	3	5%
Bra	24	39%
Sådär	16	26%
Dålig	1	2%
Använder ej informationsbäraren	16	26%

Betygsätt följande informationsbärare med avseende på hur bra de är på att förse dig med den information som är rätt för dig. - Möten



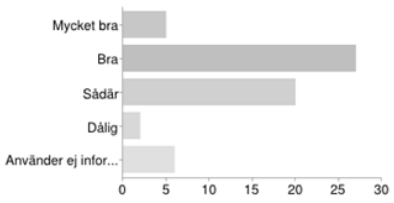
Mycket bra	15	25%
Bra	33	54%
Sådär	12	20%
Dålig	0	0%
Använder ej informationsbäraren	0	0%

Betygsätt följande informationsbärare med avseende på hur bra de är på att förse dig med den information som är rätt för dig. - Konstruktionsspec



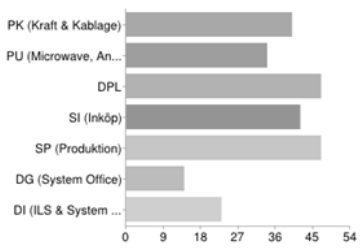
Mycket bra	3	5%
Bra	27	44%
Sådär	22	36%
Dålig	1	2%
Använder ej informationsbäraren	7	11%

Betygsätt följande informationsbärare med avseende på hur bra de är på att förse dig med den information som är rätt för dig. - Kravspec



Mycket bra	5	8%
Bra	27	44%
Sådär	20	33%
Dålig	2	3%
Använder ej informationsbäraren	6	10%

Vilka är din interna kunder, dvs. vilka behöver information från dig?



PK (Kraft & Kablage)	40	67%
PU (Microwave, Antenn & Laser)	34	57%
DPL	47	78%
SI (Inköp)	42	70%
SP (Produktion)	47	78%
DG (System Office)	14	23%
DI (ILS & System Safety)	23	38%

People may select more than one checkbox, so percentages may add up to more than 100%.

Vilken typ av information förser du din internkund med?

Information angående begränsningar inom deras område med hänsyn till mekaniken i konstruktionen. – Tillverkningsunderlag - Inköp: Vad som ska/kan köpas in - Produktion: 15189, PRI:er, COF - Lösningar på EEH ärenden och andra mek ärenden - Ritningar (MBD) - Det är väldigt olika, beror på mitt uppdrag. - Oftast dokument som sparas i IFS. - Ritningar, modeller, bilder, viktuppskattningar, tidsplaner. - Lösningar på ny konstruktion i form av produkter samt dokumentation. - Organisatoriska gränssnitt, Vägvisare - Viktigaste är val av byggsätt tidigt i projekten, senare även vilka val av komponenter eller andra konstruktionsval. - Kravspecifikationer, svar på frågor , allmän information, risk identifiering, osv - Rapporter, verifieringar- Konstruktionsrelaterad information. - Produktstrukturer i IFS. – Tillverkningsunderlag, Konstruktionsunderlag, Monteringsunderlag. - PK: Vilka vägar kablaget skall dras. - SP: Ritningar och andra underlag. - DG: Feedback på krav, hur väl dessa går att uppfylla. - DI: Hur utrymme för service kan utformas och vilka volymer somm finns att tillgå. För mig är utbytet av information och idéer åt båda håll mellan dessa instanser. - mekanikkonstruktioner - Information om den produkt vi köpt in. - Verifieringsrapport, uppgifter om tillgängliga resurser - Delar till kunddokumentation, information om verifieringsresultat, kravspecar, miljöverifieringsspecar, miljöverifieringsrapporter. - Konstruktionsverifiering rapporter, analyser, protokoll - Provresultat, protokoll, rapporter - Teknisk information. - Status i utvecklingprocess. - Provbyggnation. - Krav och info om teknik. - Samordningsfrågor tex för delsystemet - Cadmodeller & ritningar - Tillverkningsunderlag. - Nykonstruktion, krav, offerthjälp, övergripande mek info. - Inköpsspecifikation 1301-, Manualer, reservdelar, ritningar över underkontrkterade enheter - Testresultat, avstämning om hur det går i projekten, infromation i samband med slutköpsärenden.