# CHALMERS

# Feature Development Process harmonization with Lean Development

## A value stream analysis of the Feature Leaders work at Volvo Group Trucks Technology

Master of Science Thesis in the Master Degree Programme, Product Development

Karin Dahr
Marie Eliasson

# Feature Development Process harmonization with Lean Development
A value stream analysis of the Feature Leaders work at
Volvo Group Trucks Technology

# Abstract

This Master Thesis was carried out at Volvo Group Trucks Technology (GTT) in Gothenburg in order to map the Feature Development Process which is a central process in the product development. The aim was to identify conflicts and contradictions between the Feature Development Process and related processes at Volvo GTT to suggest solutions of those with Lean as guiding principle. Further a proposed update of the existing Training Material for Feature Leaders was developed. The thesis was initiated by Mr Anders B. Berle - Manager of Fuel Efficiency & Deputy Vehicle Productivity and Mr Henrik Lindh - Group Manager of Vehicle Dynamics and Brake Testing. The on-going lead time reduction programme in the area of product development at Volvo GTT was the driving target for this project. The thesis was carried out by Karin Dahr and Marie Eliasson during the spring of 2012.

The main activities to collect data regarding the current situation of the Feature Leaders work at Volvo GTT were interviews and workshops performed at the company's Gothenburg and Lyon sites. Further a survey involving the Feature Leaders at all Volvo GTTs sites: Gothenburg, Lyon, Ageo, and Greensboro, was conducted to get measurable values on the identified problem areas.

The thesis included a literature study regarding the methodologies in Lean product development. A benchmarking was conducted at three companies in different businesses. The aim was to collect information about how other organizations have improved their way of working and implementing Lean.

The result showed that there are several areas in the Feature Leaders work that can be improved. The need for an updated Feature Development Process was considered and suitable changes to it are proposed in this thesis.

The suggested improvements and recommendations are based upon the keystones of the Lean thinking investigated in the literature study and in the performed benchmarking. They regard the content in the documented Feature Development Process as well as the way of working in the area of Features and overall operations in Product Development at Volvo GTT.

*Key words:* Lean in Product Development, Value Stream Mapping, Feature Leader, Visual Management.

# Acknowledgement

Gothenburg, 2012

*Karin Dahr & Marie Eliasson*

# Table of Contents

# Nomenclature

**Administrative Environment:** *Areas of the organization that are not the production, i.e. where project work of different types are performed.*

**Balance (operation):** *Balancing is to make a trade-off between different parameters to make sure that a requirement or the complete requirement specification is possible to meet.*

**Delegated Feature Leader:** *The Feature Leader can delegate the work to a Delegated Feature Leader if the work load is too high.*

**Complete Offer Requirement Owner (role):** *The CORO is a member of the pre study group who translates needs into achievable and verifiable requirements. Distributes requirements to Product Systems and in case System requirement areas are insufficient, to Vehicle Modules.*

**Current status:** *Issued from simulation, measurements or analysis on components and/or complete vehicles and compared with requirements at the current stage of development within the projects.*

**CPM:** *Chief Project Manager*

**FL:** *Feature Leader*

**Forecast at Serial Production (SP) start:** *Estimation of the achievable feature level at start of production regarding the current project status and action plans.*

**Friday Vehicle:** *Vehicle that will be replaced by the new project. From a feature viewpoint, it represents the current vehicle with estimated modifications according to the bridge plan at the time when the new project goes into serial production.*

**Feature contract:** *Document approved by all involved parties in the project (FL, PMFVV, CPM, PDPM, and PPL). It provides an agreement on the achievable features requirements, defined in the Requirements Specifications, fulfilled by the serial product in accordance with the project description.*

**Feature status:** *During Feature reviews, Feature Leaders report progress to the Project Team. They clearly indicate the current status regarding expected gate deliverables and requirement fulfilment. To set the status in a consistent way, the "traffic light", defining green, yellow and red feature status, is used.*

**Feature Verification and Validation Plan (FVVP):** *The plan for verification and validation tests at Volvo GTT.*

**FLGOT:** *Feature Leader Gothenburg. A local network in Gothenburg directed toward the development of Feature Leaders work and feature.*

**Feature Coordination Team (FCT):** *Network of experts working with the vision for the future of a set of features, expressed in a Feature Development Plan.*

**Feature Leader (FL):** *The function responsible for the feature.*

**Feature Development Process (FDP):** *The process that describes the development of a feature in projects at Volvo GTT.*

**Feature Verification and Validation (FVV):** *The department for verification and validation at Volvo GTT.*

**Global Development Instruction (GDI):** *Instruction describing a process at Volvo GTT.*

**Global Development Plan (GDP):** *The overall product development plan at Volvo GTT.*

**PDPM:** *Project Development Project Manager*

**PMFVV:** *Project Manager Feature Verification and Validation*

**Project Wanted Position (PWP):** *The position, compared with competitors in the competitive set for each target vehicle, where each Brand should be at the end of the project. Expressed by segments in 3 levels: Leader, Among Best, and Competitive.*

**Protus:** *Error report in projects.*

**Project Pre-requisites:** *Document containing targets from all stakeholders, structured by the Target Areas and the Base Product Specification (BPS).*

**Product Planning (PPL):** *Performs the product order.*

**Requirement:** *A requirement is a condition or capability that must be met by a product or that it needs to have as an attribute. It must be possible to verify. A requirement is an output from the cross-functional pre study team, documented in the Requirement Specification.*

**Requirement Areas:** *The Requirement Area structure is a generic outline, which assures the complete description of product targets and requirements.*

**Requirement Specification:** *This document contains measurable requirements at Complete Offer, Product System and Vehicle Module level in Requirement Areas, balanced and translated from the targets in the Project Prerequisites.*

**Requirement Manager (RM):** *The function that is responsible for the Requirement Specification.*

**Requirement Specification (RS):** *A document containing the requirements regarding each project at Volvo GTT.*

**SMART:** *The approach is applied when requirements are specified. The requirements must be: Specific, Measurable, Attainable, Relevant and Traceable.*

**Systems Engineer (role):** *It is a profession that facilitates the Systems Engineering process. Systems Engineering is a function within Platform management.*

**Systems Engineering (process):** *Systems engineering is a structured iterative process using an interdisciplinary approach to develop a life-cycle-balanced system that satisfies stakeholder needs and expectations.*

**Team Place:** *Electronic data base shared between different employees.*

**Technical Feature Requirements:** *Requirements broken down to satisfy the customer feature requirements (referred to levels 4&5 in the feature structure), verifiable by virtual evaluation, i.e. simulation, or by physical testing with measurements.*

**Target (input):** *Is an input to the pre study team from stakeholders and documented in Project Prerequisites. It is a demand for something necessary, expressed by the stakeholder, in the stakeholder language and unbalanced with other stakeholder targets.*

**Volvo GTT:** *Volvo Group Trucks Technology.*

**Vehicle Module (or module):** *A defined, geometrical package of components making up one module of the vehicle with distinct function defined interfaces and defined variant families. A vehicle module is built of sub-modules.*

**Wanted Feature Position (WFP):** *The position compared with competitors, where each Brand should be in a future perspective. Expressed by the segments: Leader, Among Best, and Competitive.*

**White Book:** *A Lesson Learned book for each project.*

# 1 The Company - Volvo Group Trucks Technology

Volvo Group Trucks Technology (Volvo GTT) is a part of Volvo Group which is a global and multi branded organization with products in many areas, trucks, construction equipment, marine power, industrial engines & systems, and aerospace. Further, Volvo GTT provides services within finance, IT, and logistics. The truck brands of Volvo GTT are Volvo, Renault Trucks, UD Trucks, and Mack. The brands in the other product areas are Eicher, Volvo Penta, Volvo Aero, SDLG, Prevost, and Nova Bus.

Volvo GTT is a cross functional built up organization, with projects and processes involving different functions located at different groups and spread geographically over the world.

Volvo GTT consists of different brands in several countries with different cultures and backgrounds in their way of working. This consequently directs the company to continuously work on implementing uniform ways of working throughout the organization.

At the beginning of 2012, Volvo GTT underwent a re-organization and former enterprises Volvo Powertrain, Volvo 3P, Volvo Parts, and Volvo Technology were brought together as one corporation. The re-organization also induced renaming of some departments and one of them is the department of Feature Verification and Validation (former Complete Vehicle).

## 1.1 Features

The features are the main drivers in a project at Volvo GTT. A truck is constituted by 34 features which together as a coherent whole provide Volvo GTT with superior products. The customers express their expectations based on the feature characteristics and the improved features bring increased customer value. It is considered that they are the core within the Volvo GTT business and makes it possible to be competitive.

The different features can be viewed in Table 1.

**Table 1.** The features at Volvo GTT.

| 7 Feature Areas Level 1 | Description | 32 Customer Features Level 2 | |
|---|---|---|---|
| **1. Quality & Uptime** | -A reliable truck | Reliability | Durability |
| | | Maintainability | Quality impression |
| **2. Safety** | -A safe truck | Visibility | Collision safety |
| | | Braking | Collision compatibility |
| | | Handling | Personal & Vehicle security |
| | | Driver assistance | |
| **3. Driver Environment** | -A comfortable truck | Driver position | Ride comfort & vibrations |
| | | Driver interface & Communication | Resting comfort |
| | | Climate | Working comfort |
| | | Interior noise | Entry & Exit |
| **4. Environment** | -A friendly environmental truck | Exhaust emissions | Materials and environmental impact |
| | | Exterior noise | |
| **5. Driving performance** | -A fuel efficient truck | Fuel Economy | Driveability |
| | | Average speed | |

| 7 Feature Areas Level 1 | Description | 32 Customer Features Level 2 | |
|---|---|---|---|
| **6. Transport effectiveness** | -A truck for business | Load capacity | Transport Security |
| | | Load handling | Vehicle agility |
| | | Logistics | Suitability for bodywork |
| **7. Product Message** | -An image carrier | Brand identity | Aesthetic Expression |
| | | Feature expression | |

# 2  Introduction

A core business within the truck development at Volvo Group Trucks Technology (Volvo GTT) is the development of Customer features. Each feature corresponds to a customer need and is the foundation for a product realization. Durability, reliability and maintainability are examples of the total 34 features constituting the truck. Each feature is broken down to product requirements which are the basis for the development of the product solution.

The central process at Volvo GTT product development is the Feature Development process (FDP) that has been refined in the last years. There are related processes that are complementary but also overlapping and to some extent can be conflicting. There are currently on-going initiatives within Lean Development in a lead time reduction programme called RnD30.

A central role in the Feature Development Process is the Feature Leader role. The Feature Leaders are often asked to report status in projects to the stakeholders. In a yearly survey, the Feature Leaders respond to several questions that will serve as important background information.

In addition to the input from Feature Leaders, mainly within the Complete Vehicle organization, this work will also involve contacts with Product Planning, Systems Engineering and the Project organizations.

This is the official report of this project, but it does not contain all results due to confidential requests from Volvo GTT. Documents that are not included in this report are: Updated Feature Leader Training Material, updated instruction of the Contract, updated Feature deliverables flowchart, and new establishment of a Feature Leader role description.

## 2.1  Purpose

The main task of this Master Thesis project is to determine the process flow of the Feature Leaders work in a larger project as reference. It aims to identify existing conflicts and needs in order to improve and update the Feature Development Process to propose refinements in the interaction with related processes. The focus has been to provide Volvo GTT with the information needed in order to improve their situation to become even better in a qualitative perspective.

## 2.2  Objectives

Propose improvements of the Feature Development Process in order to eliminate non-value adding factors, taking into account state of the art input. This includes identifying and solving existing conflicts/contradictions with related processes, as well as proposing updates of the interaction with the related processes. The aim is to reduce lead times within the Feature Development Process. Lean during product development of Customer Features should be guiding principles.

## 2.3 Scope

The focus will be on the Feature Development process and interface with related processes, concerning Volvo Group Trucks Technology and on the documentation of the process update in a training material.

## 2.4 Actors and stakeholders

Stakeholders and actors of this project are mainly The Feature Leaders at Volvo Group Trucks Technology and the supervisors at Volvo Group Trucks Technology: Mr Anders B. Berle - Manager of Fuel Efficiency & Deputy Vehicle Productivity, and Mr Henrik Lindh - Group Manager of Vehicle Dynamics and Brake Testing. Actors within the processes related with the Feature Development Process; Product Planning, Systems Engineering, Design, Test, Calculation, and Project Management, are also interests in this project.

## 2.5 Delimitations

The focus will be on the Feature Development Process and how it is interacting with the SE, $CV^3P$ and PPL Processes. A process mapping will be executed on the Feature Development Process and its connections to the related processes. This thesis objective does not include estimating costs or lead time reduction.

# 3 Empirical part of the Master Thesis - processes and terminology at Volvo GTT

This chapter describes the different processes and terms that are related to the Feature Development Process. The most central parts in the Feature Leaders work which have been the main focus for the investigation by this Master Thesis work are described.

The product development at Volvo GTT is described by the company's own product development process, the Global Development Process (GDP), Figure 1, which is also the foundation for the other processes within the organization. The purpose is to provide a coherent uniform approach in order to put all the processes in the context of being built up by the same gates. The GDP describes the major phases and gates that projects consist of. The gates in projects at Volvo GTT are: Product Change Initiate Decision (PDI), Feasibility gate (FG), Concept Study Gate (CSG), Concept Gate (CG), Development Gate (DG), Freeze Gate (FG), Final Development Contract Gate (FDCG), Industrialization Gate (IG), Pre-production Gate (PPG), Launch Gate (LG), Release Gate (RG), and End Gate (EG). Each process at Volvo GTT is described in a Global Development Instruction (GDI). The processes describe the activities and deliverables prior to each gate that are important for the certain process more in detail.
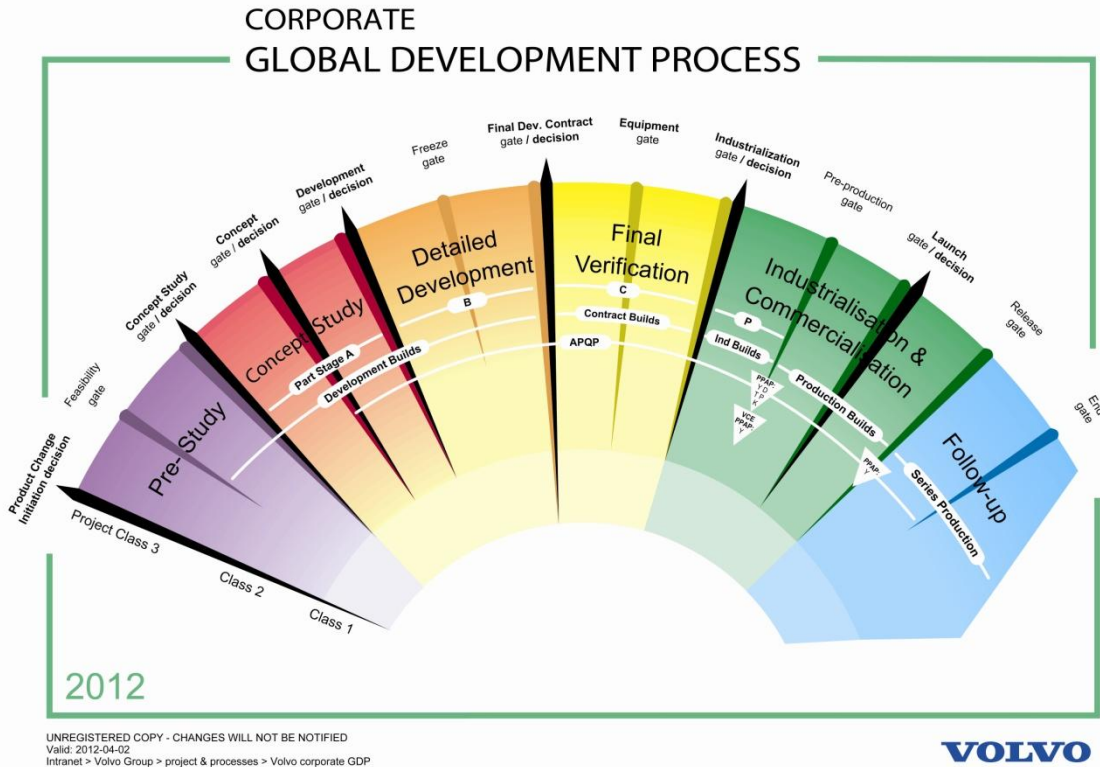


**Figure 1.** The Global Development Process at Volvo GTT. Reference: www.violin.com.

Features are central in the Product Development at Volvo GTT. There are two main domains within feature context at Volvo GTT, customer features and technical features. Volvo GTT describes the customers' expectations, requirements and needs on the product with customer features. The technical features can be described as the domain created by the breakdown of customer features into technical requirements.

There are 34 customer features which describe the entire truck from durability to the driver interface. For each feature there is one responsible Feature Leader who acts as the voice of the customer and is responsible for the fulfilment of the requirements. The Feature Leader cannot manage the work themselves, so delegated Feature Leaders can be assigned to assist the Feature Leader in the work. The majority of the Feature Leaders at Gothenburg site belong to the department of FVV, and two Feature Leaders belong to Cab department and one belongs to the Electrical department. The sites Lyon, Ageo, and Greensboro do not have the same Feature Leaders structure.

The Feature Development Process (FDP) aims to describe the way of working with customer features throughout projects and how requirements are broken down, verified and validated. It is the Feature Leader that is responsible for the requirement breakdown as well as for the verification and validation requirement fulfilment. The FDP is based on the Global Development Process (GDP) which describes the process of product development projects.

Product Planning (PPL) is the function that initiates product development projects and that provides projects with pre-requisites which can be described as a wish list of the deliverables of the project.

The translation of pre-requisites into requirements and the breakdown of requirements are documented in a Requirement Specification (RS) which is stored in a database called Serena. Serena is today mainly used by the Requirement Managers (RM) which belongs to the department and process of Systems Engineering (SE). The requirement documentation is described in the Systems Engineering Process. However, extraction can be made of the Requirement Specification from Serena into Excel. The requirements are verified and validated according to the Complete Vehicle Verification & Validation Plan ($CV^3P$) which describes the activities for verification and validation of features and vehicle regulation. The Project Manager at Feature Verification & Validation (PMFVV) is responsible for the $CV^3P$. Each Feature Leader is responsible for providing a sub Verification and Validation plan (sub V&V-plan) for their feature. The Feature Leader shall also provide an estimation of the required budget for performing the tests, a sub Cost-plan. The $CV^3P$ is the collection of all sub-V&V-plans and sub Cost-plans provided by each Feature Leader involved in the project.

Except from RM (SE) and PPL Feature Leader interacts with project managers, test engineers, design engineers, calculation engineer, electrical engineers, and product design. Even if the Feature Leader is responsible for the requirement breakdown for his/hers feature, it has to be agreed with engineering, in order to develop concepts. If there is a problem in agreement of the requirements or if the requirements are contradicting, a balancing procedure which is owned by SE is initiated. Considerations are taken to determine changes in the achievement level of the requirement which is updated in the Requirement Specification up to FDCG.

Prior to each gate the Feature Leader reports status on the feature and its fulfilment in the project to the PMFVV. The status on all impacted features is communicated to the Chief Project Manager (CPM) and the Project Organization at so called Feature Reviews (FR). The feature gate status contains the current status of the achievement of the feature requirements and the confidence to achieve requirement fulfilment at Serial Production (SP) start. It is communicated by the Feature Leader filling in a Feature Gate Status Template. The status of requirement fulfilment is symbolized by the use of a "traffic light". The colours green, yellow, and red form a code which is used to communicate the requirement fulfilment, where green means that the requirement is/will be fulfilled and the target will most likely be reached at SP start. Yellow means that the requirement is not fulfilled but a developed action plan will most likely ensure that it is reached at SP start. Red means that the requirement is not fulfilled and there is no action plan for achieving fulfilment at SP start.

Prior to FDCG an agreement shall be made between the Feature Leader, CPM, PPL, PMFVV, PDPM, and Brand on what the project will deliver, i.e. which pre-requisites that can be fulfilled based on which customer feature target level that is considered to be reached at SP start. The commitment is made by signing a template called Feature Contract which contains the achievable customer feature target level. The Feature Contract implies that deviations from initial requirements are definitely approved and no changes will be approved without the steering committee or ad hoc decision body.

The Project Delivery Plan (PDP) is a tool to plan and establish the deliveries for each development loop of activities up to FDCG for each project. It will provide the possibilities to document the results of the verification and validation tests performed. It is the Feature Leader that is the owner of and responsible for of the PDP. It is closely linked to the Verification & Validation plan of the feature and it is central that these are synchronized.

## 3.1 RnD30 – Lead time reduction programme at Volvo GTT

At the moment Volvo Group Trucks technology runs a lead time reduction programme called RnD30. It aims to reduce the costs within the Research and Development area by with 30 %. Twenty per cent of these thirty per cent will be achieved by reducing the lead times and ten per cent will be achieved by reducing the number of parallel run projects. This Master Thesis work was developed and initiated due to the lead time reduction programme, which is reflected by the aim of reducing lead times in the Feature Development Process.

# 4 Methodology

This section briefly explains and describes the choice of procedure, materials, and participants that have been used in this Master Thesis work and the structure of the work performed. All the parts described in this chapter will be described more in detail later.

## 4.1 Procedure

This Master Thesis work has been divided into a planning, research, data collection and a data analysis phase.

### 4.1.1 Planning

The first step that was performed in this Master Thesis work was to plan the work. The plan was described and documented in a Planning Report which is not included in this report. The report describes what the project team estimated to be accomplished during the Master Thesis and a time schedule for the team to follow during the work. The planning report is also a mandatory delivery for this project in order to get this work approved according to the guidelines of Chalmers University of Technology. In the planning phase a Risk Analysis was conducted in order for the team members to be aware of possible risks that could possibly delay or complicate their work.

### 4.1.2 Literature study & Benchmarking

Research was performed in order to determine the best procedure to collect data and to determine non-value adding factors, conflicts and contradictions in the Feature Leader work. The research was performed by a literature study in Lean and by benchmarking how other companies have conformed and implemented Lean ways of working in their organizations.

### 4.1.3 Performance

Data collection was performed by interviewing Feature Leaders, but also people at other functions such as Systems Engineering, Product Planning, Project Managing, Engineering, and Test engineering, which are interacting with the Feature Leaders' interviewed. Different types of interviews such as individual interviews, workshops and group interviews were conducted in order to get an as good picture as possible of the Feature Development process and the Feature Leaders' work. The sessions described below are clearly described in chapter 8.

The data collected were based on the sessions:

- *Individual interviews* have been performed with Feature Leaders and other functions interacting with Feature Leaders. The aim was to get an overall understanding of their work throughout a project, and what they perceive as working well and/or less well in their work.
- *Individual workshops* were performed with Feature Leaders for two different purposes. Firstly, to create a foundation for the Cross Functional Workshop in order to identify the general activities that Feature Leaders are performing in a project. Secondly, enabling an analysis of some of the problem areas in the Feature Leaders' work that had been identified during the interviews. The problem analysis was performed with the Cause and Effect method in order to find the root causes.

- *Cross Functional workshop* in order to perform a Value Steam Mapping (VSM) of the Feature Leaders' work. Different functions were involved in the VSM in order to get the entire view of a project performance, including inputs and outputs, of the Feature Leaders' work. The workshop was performed on five different features, one by one. When the VSM on the different features was performed there was a review session for all the involved functions. As a final phase the information flow throughout the work was viewed together with a Feature Leader.
- *Group interview:* A group interview influenced by the focus group methodology was conducted with four Feature Leaders and one Feature Coordination Team leader (FCT leader). The different problem areas that were identified during the individual interviews and Cross Functional workshops were discussed as well as possible solutions to the problems. The aim was to involve the Feature Leaders in how the problems can be solved and get their opinions about what the best way of working for them is.
- *Survey*: A survey was sent out to the Feature Leaders at all the sites, Gothenburg, Lyon, Ageo, and Greensboro, in order to get measurable answers to what the Feature Leaders perceives as problems in their work. The survey was also a method for confirming already specified problems that were identified during interviews.
- *Experiments*: In order to determine how much of the Feature Leaders' work are devoted to non-value adding activities, an experiment were performed with two Feature Leaders. In the experiment the Feature Leaders filled in a document on which they stated how often during a day they were interrupted in their work.
- *Benchmarking*: In order to gain knowledge about how other organizations are working and have implemented Lean in their project related work. The benchmarking was performed at three different companies*:* Volvo Cars Corporation, Ruag Space AB, and Ericsson. At Ericsson AB and Ruag Space AB Lean managers were interviewed and at Volvo Cars Corporation a Lean specialist was interviewed. The Benchmarking study is presented in this report as an own chapter and report, containing the significant data collected.

### 4.1.4 Result

Analysis of the collected data was performed based on the methodologies from the literature study. The analysis was performed on the major problem areas identified. The root causes of the problems were analysed by the Cause and Effect method and mind map. The FL Training Material suitability was evaluated with Feature Leaders. Further the outcome from the VSM of the Feature work was compared with the FDP and the comparison was evaluated in order to suggest updates of the FDP.

## 4.2 Material

This Master Thesis has not required any specific hardware equipment and the software that has been used is the MS Office Package (Word, PowerPoint and Excel). However, a major part of the work has been performed by the use of paper sheets, felt tipped pens, and sticky notes in the Value Stream Process mapping procedure.

## 4.3   Participants

The individual workshops were conducted at the Gothenburg site and the individual interviews were mainly performed in Gothenburg (31 interviews) and in Lyon (9 interviews) with Feature Leaders, Project Managers, Requirement Managers, Product Planners, a Design Engineer, a Calculation Engineer, and a Test Engineer. The Cross Functional workshops were performed in Gothenburg and Lyon. The objective has been to map and evaluate the uniform Feature Development Process of the four sites Gothenburg, Lyon, Ageo, and Greensboro. However, it was not possible during the time available to interview Feature Leaders at all the sites. Therefore, the work has primarily been focused on Gothenburg and secondary on Lyon. However, all four sites were involved and regarded in the survey.

# 5 Risk Analysis

A risk analysis is a significant tool and document that is of quality purpose when running a project. Projects often involve people, systems, interactions, devices etc. which all contributes to affecting the reliability of the working procedures. All factors that can affect a project are regarded as risks and may influence the quality of the project result. Deviations in a project are often more a rule than an exception which makes it important to focus on the risk those deviations happens in the work and perform an action plan in advance. In order to identify what deviations that can happen it is significant to state what impact the deviations will have on the project. It is also central to state what actions that are needed to prevent the deviations to occur as well as what actions that will minimize the impact on the work if they accidently occurs anyway (Eppinger & Ulrich, 2008).

A Risk Analysis was carried out for this Master Thesis work in order for the team members to be alert on happenings that can affect the project (the identified happenings can be viewed in Appendix A). The happenings are arranged in different classes of likelihood to occur and with respect to their consequences they will contribute with if they occur. They are also coded with different colours based on the need for action plan if they occur which were the foundation for the development of action plans (see Appendix B). Green colour indicates that it is a low need for an action plan, yellow that there is a medium need, and red that it is a high need of an action plan (Maylor, 2010).

## 5.1 Risks outcome in this project

This project has proceeded without any major deviations from the scheduled plan. Activities have been executed according to the Gantt schedule in the Planning Report. Events that occurred that are stated in the risk table Appendix A were related to the interviews performed. All participants attended the sessions that were planned. However, the Master Thesis team needed to wait for participants in some cases, because people showed up later than scheduled. It did not have any major consequences, but resulted in shorter than planned sessions, and all questions that were scheduled were asked and answered.

Unplanned presentations at FLGOT were also events that were not planned in the Gantt schedule. However, it was determined that those occasions were more of favourable deviations that contributed positively to this project.

In summary, the Master Thesis team has not experienced any major events with negatively have effected on outcome of the work.

# 6 Literature Study

This chapter will describe the Lean theory in Product Development and its focus on waste reduction in organizations.

## 6.1 Lean

Lean is a mind-set with the aim to reduce waste as much as possible. It has its origin in the Toyota production line, where the purpose is to decrease the time between customer order and delivery of the end product. Nowadays it is practiced throughout entire organizations. Lean is about delivering the right thing, at the right time, and in the right amount. The aim is to have a flow that concentrates on adding value to the customer. Everything that the customer does not perceive as value adding to the end product shall be reduced, or ideally eliminated. Non value adding activities are for example re-work, waiting, downtime and inspection [(Summers, 2011) and (Harry et al, 2012)].

Womack and Jones (2003) consider the factors of waste as activities that require corrections, unnecessary steps and phases in processes, transportation of employees and/or material from one location to another without any purpose. Results that are not meeting the customer requirements and lack in the synchronizing of a downstream and an upstream group of people interacting in a project are other factors to consider. (Womack and Jones, 2003). Lean provides opportunities for organizations to produce more. The opposite to waste in Lean is "pull", which means that the products are produced at the same rate as the customers buy them. A pull system provides resources to the process at the same rate as they are used [(Summers, 2011) and (Harry et al, 2012)].

## 6.2 Lean in Product Development

According to Holmdahl (2010) there is a widespread opinion that the methods used in Lean production can be applied in product development. Holmdahl (2010) argues that Lean Product Development (LPD) in fact was developed by the founders of Toyota, before the Toyota Production System even was created. The founder of the Lean production term advised the term not to be used in product development context. He regarded the differences to be major between the characteristics of production and product development. This statement was based on the fact that product development loops are often used in order to implement new knowledge during a project, which can create the possibilities to maximize value in the product. In the production environment, loopbacks are often an indication of mistakes and errors and are therefore considered as an activity of rework. In product development it is also impossible to foresee all features before making a physical mock-up or model, which also indicates that the product development process has to be iterative Holmdahl (2010).

According to Letens et al (2008), Lean Product Development became interesting when it was realized that growing pressure from competitors required a faster product development. It was considered that product development in engineering is the main bottleneck that contributes to defects and delays of providing the customer with superior products. Letens, et al (2008) describes the way to enable a Lean product development environment as to provide projects with Lean achievement scorecards. They describe how well the project is proceeding based on the different levels of Lean accomplishment. The project teams are

delegated areas within Lean methods to achieve during the project. If they do, they will be awarded. This is a way to endorse people to believe in the importance of the Lean implementation purpose and objectives (Letens et al, 2008).

The intellect of the employees can also be wasted. Lean methods focus on reducing these types of waste by using adequate tools, efficient layouts, training, qualified suppliers, standardization, good management and good communication. The main key performance measures connected to Lean are cycle times and how often a product is completed by a process. Value-creation time is when an activity is transforming the product in a way that the customer is willing to pay for. Lead time is how long it takes for one item to move all the way through a process from start to finish (Summers, 2011). Ward (2007) regards the main waste in product development as the waste of knowledge. The question is if an activity contributes to a profitable or non-profitable value stream throughout a project to the end customer and how much knowledge it creates. Lean organizations are focusing more on increasing the knowledge that is useful for the organization and its employees. This will, according to Ward (2007), decrease the need for applying additional hardware tools to solve problems and non-value adding activities. Womack and Jones (2003) also emphasize the importance of Lean thinking in organizations due to their ability to use fewer/less resources to produce the same result. Lean will provide the prerequisites needed in order to be proactive and identify the problems before they occur and use them as opportunities to continuously improve.

Ward (2007) exemplifies the definition of the term waste in product development as a cleaner mopping the floor at a customer. The actual mopping itself adds value to the end customer but the time of changing water in the pail is time that the customer does not want to pay money for. According to Ward (2007) is this time considered as waste since the activity brings no value to the customer, even though it is regarded as necessary. Engineers in the U.S devote around 10-30 % of their daily work to value adding activities in their daily work. This statement is often based on the lack of quality in the development system. Another factor that provides project defects is the throwing away of knowledge that the organization already possesses (Ward, 2007).

There are several sources of waste in product development according to McManus (2005) and Power (2012):

1   Waiting: *People waiting for information and information waiting for people.*
2   Inventory: *Too much information, multiple information, redundant sources, outdated/obsolete information and just-in case information.*
3   Excessive processing: *Excessive/custom formatting, fragmented reports, unnecessary serial processing and excessive approval of information release.*
4   Transportation: *information handled by multiple people before arriving at user, information hunting, data re-formatting or re-entry and switching computers to access information.*
5   Unnecessary Motion: *Walking to information, retrieving printed materials, ergonomic environment (e.g. no optimal layout of physical environment), unnecessary transportations in databases and poor physical arrangement or organization.*

6    Overproduction: *Unnecessary detail and accuracy push and not pull data, information, over dissemination, print documents before needed, buy things before they are needed and, send documents before the next person in the chain is ready to work with them.*

7    Defects: *Errors in data/reporting/entries, errors in information provided to customers and information that does not make sense to user*

8    Rework: *Wrong inputs, design errors, changes in construction, budget misses and new employees that do not have the complete knowledge regarding their work.*

9    Storage: *Drawers overfull with work, storage, brochures, handling of business documents and reports overfull.*

10   Unused creativity: *Limitation of responsibilities for basic operation, steering committees control and inappropriate methods.*

**Table 2.** Process Principles of Lean Product Development, Reference: Liker and Morgan (2006).

| Principle | Description |
|---|---|
| 1. Develop a "Chief Engineer system" to integrate Development from start to finish. | The Chief Engineer is the master architect with the final authority and responsibility for the entire product development process. The Chief Engineer is the overarching source of product and process integration. |
| 2. Organize to balance Functional Expertise and Cross-functional Integration. | Deep functional expertise combined with super ordinate goals and the chief engineer system provides the balance sought by matrix organization. |
| 3. Develop Towering Technical Competence in all Engineers. | Engineers must have deep specialized knowledge of the product and process that comes from direct experience at the gemba. |
| 4. Fully integrate Suppliers into the Product Development system. | Suppliers of components must be seamlessly integrated into the development process with compatible capabilities and culture. |
| 5. Build in learning and continuous improvements. | Organizational learning is a necessary condition for continuous improvement and build on all of the other principles. |
| 6. Build a Culture to Support Excellence and Relentless Improvement. | Excellence and kaizen in the final analysis reflect the organizational culture. |

**Table 3.** People Principle of Lean Product Development, Reference: Liker and Morgan (2006).

| Principle | Description |
|---|---|
| 7. Establish customer-defined value to separate value added from waste. | Lean is a never ending journey of waste elimination. Waste is non-value added defined by first defining customer value. |
| 8. Front load the Product Development process to thoroughly explore alternative Solutions while there is Maximum Design Space. | Defining the wrong problem or premature convergence on the wrong solution will have costs throughout the product life cycle. Taking time to thoroughly explore alternatives and solve anticipated problems at the root cause has exponential benefits. |
| 9. Create a levelled Product Development Process flow. | Levelling the flow starts with stabilizing the process so it can be predicted and appropriately planned. This allows product planning to reduce wild swings in work load. Predictable work load swings can be staffed through flexible labour pools. |
| 10. Utilize Rigorous Standardization to reduce Variation, and create Flexibility and Predictable Outcomes. | Standardization is the basis for continuous improvement. Standardization of the product and process is a foundation for all the other process principles. |

**Table 4.** Tools and Technology Principles of Lean Product Development, Reference: Like and Morgan (2006).

| Principle | Description |
|---|---|
| 11. Adapt Technology to fit your people and process | Technology must be customized and always subordinated to the people and process |
| 12. Align your Organization through Simple, Visual Communication | Aligned goals must be cascaded down and joint problem solving is enabled simpler, visual communication |
| 13. Use powerful Tools for standardization and organizational learning | Powerful tools can be simple. Their power comes from enabling standardization which is necessary for Organizational learning |

To provide a smooth flow in the product development process, Lean Product Development adoption is required according to Foquet and Gremyr (2007). Concurrent Engineering, Visual Management and Visual Communication are factors that are critical to apply (Foquet and Gremyr, 2007). In order to provide Lean Product Development three areas of principles must be considered according to Liker and Morgan (2006). They can be visualized in Tables 2, 3 and 4, and are described below. To accomplish the principles it is significant to view Lean as a system. The system constitutes different factors that interacts and must be integrated as a coherent entity in order to work. The implementation of Lean requires much time of the introduction establishment of Lean. This is due to the need for commitment and understanding of the principles around the organization according to Foquet and Gremyr (2007).

**Process Principles of Lean Product Development**
According to Summers (2011), Dr Deming (1900-1993) taught organizations to improve their management strategies. He considered the quality process improvement activities to be the starting point for a chain reaction in organizations demand for strengthens their financial situation. If quality improves, costs will decrease and that will lead to fewer mistakes and delays and better use of resources, which gives the organization the possibilities to capture a larger market. In turn it helps the company stay in business and increase the number of employees (Summers, 2011).

According to Liker and Morgan (2006), every process needs to be defined by its customer's demands. The starting point in all processes is the customer and also where the organization is directed at all times. The view, considering that the customers always come first, creates alignment out of conflicts according to Liker and Morgan (2006). The key steps to Lean improvements of how to work more efficiently in processes are to study the process and identify the flow and the connections, and then eliminating non-value adding activities.

A process that works optimally in the company will also contribute with positive results, it is just a matter of the perspective that one has on the process influence on the organization outcomes of the provided products. The core is within the philosophical way of thinking and the awareness of the beliefs is significant when creating processes. Basically it is the principles that provide the optimal processes with the support of the employee's continuous improvements and updates. Toyota defines processes in Product Development as far away identical with manufacturing processes which is also stated by Holmdahl (2010). Product Development ways of working is much more complex and constitute a much broader process. By this viewpoint Toyota has been able to refine and standardize their processes, eliminate waste and reduce lead time and costs. Functions interacting in a project could be skilled in their areas at all levels. If their actions are not regarded to be the best for the project and the customers their competence is not functional. The philosophy according to Liker and Morgan (2006) is to establish the view in the entire organization to serve the customer in all activities performed. An optimal process provides qualitative outcome out of activities the very first time it is performed which is also stated as "Do it right the first time" terminology. It indicates the importance of reducing rework and later refinements in projects which often leads to enormous costs. In order to constitute a "Do it right the first time" action in an organization, Liker and Morgan (2006) advocates the Toyota way of working to focus on the *Kentou* (study period). It is a period of time in the early stage of the

project and involves sessions of generating ideas of drawings and discussions and evaluations of optimal solutions. This aims to create system compatibility at an early stage in order to reduce the need for refinements and changes in the later phases of the project. It can be done before the design is fully accomplished. The pre-study period makes it possible to provide a faster product development process with fewer changes in the later phases of the project (Liker and Morgan, 2006).

Liker and Morgan (2006) define the Lean Product Development process as a system that is continuously improved. At Toyota continuous improvements are the basis for their success in the areas of providing shorter lead times. It is a method that is anchored thoroughly in the organization and is used on a day-today basis. Continuous improvements are crucial to apply in order to become leader in applying improved quality throughout the organization (Liker and Morgan, 2006).

In order to achieve a structured process with a continuous flow, the process must be in balance, no overproduction. Value stream mapping and Kanban systems can be used in order to determine where line balancing is needed. Line balancing is about finding the tact time of the different process steps, meaning the time to perform/produce one item/work task is in line with what the customer is prepared to pay. Tact time does not leave any margins for producing more than what is ordered from the customer and no operation should take longer time then the tact time. However, the importance that the operation adds value to the customer and end product must be underlined and considered (Summers, 2011).

**People Principles of Lean Product Development**
Toyotas way of working is based on the fact that organizations are built around people. The people system is a crucial keystone to provide successful outcomes. The factors that are part of the people system are according to Liker and Morgan (2006): training and professional development, recruitment and selection of engineers, leadership styles, institutional learning and memory, organizational structure and culture. It is critical for all organizations to ensure that all employees are directed towards the same goal. Therefore the level of culture differences is critical, which means to what degree the employees in the entire organization share beliefs, values, symbols and language. The main factors of the principle regarding individuals in the organization are to focus on developing the employees, in order for them to continuously improve the processes and products, as well as challenging the existing way of working with new approaches (Liker and Morgan (2006).

If a company wants to succeed in the area of quality throughout the organization, they need to consider the importance of continuously educating the employees in the quality area. Training is a keystone to influence the attitudes and the skills of all employees in the organization. Quality training is becoming more and more used at all levels of companies from operator to top management. (Sandholm, 2000). Additional core factors of providing people principles are the importance of establishing technically skilled employees and design resources. When new employees are hired at Toyota a long term career track of their discipline is established in order to secure the competence and technical skills of the employees further. To know the product is essential for all employees and therefore the

production line is often the starting point for a career as an engineer at Toyota (Liker and Morgan (2006).

Generally, suppliers are not only distributor of goods they are also an information base of competence. Their expertise should be regarded as a forum and a way of learning by using their knowledge. Suppliers should be integrated into the product development processes by having guest engineers from different suppliers and letting them share their skills and competences into the organization Liker and Morgan (2006).

The organizations values and beliefs must be impregnated throughout the company. The viewpoint must be oriented and shared in the same way, from bottom to the top. Toyota specified the "DNA" factor, which implies that the employees have the same DNA of the principles and values that make up the whole company. For example, at Toyota one core value is "satisfying customers". All decision making sessions are distinctly performed based on what is best for the customers' experience. Liker and Morgan (2006) refer to the fact that a usual way of action in companies regarding this subject is that decisions are often performed based on a person's career possibilities and not on the customers' value (Liker and Morgan, 2006).

**Tools and Technology Principles of Lean Product Development**
Focusing on long term perspective is a fundamental part to provide Lean in Product Development. The choice of tools and technologies to support developing and producing products is critical according to Liker and Morgan (2006). However, sufficient tools and technologies can never manage success if the product development process itself is not optimal. High level technology on its own will never provide competitive benefits. It is the processes around that must be adapted and the technology adjusted in order to correspond to the disciplined processes. The people and processes must at first be optimized and correct and then the technologies can be added into the organization. Processes must be supported in order to provide proactivity and eliminate problems that occur along the way when working in projects. Information must be communicated visually and be informative. Policy Deployment is a Toyota tool used to break down high level requirements to more detailed and meaningful requirements. Toyota uses the A3 report approach. The four areas to state on the A3 reports are: Proposals, Problem solving, Status reporting, and Competitive analysis. There are many ways to illustrate these areas of information. The main concept is however the understanding of informing in an optimal way, by the use of a simple visual format (Liker and Morgan, 2006).

Basically, continuous improvements cannot be achieved if there is no standardization established in the organization. According to Liker and Morgan (2006) it is the use of specific tools that makes it possible to enhance new learning into a standardized way of working, for example mapping processes in order to identify potential areas to standardize. However, even if there are standardized ways of working the tools must be maintained by roles in the organization that actually performs the work. A systematic way of working is crucial in order to provide Lean in Product Development. The interaction of processes, people and tools and technology makes the system complex and demands the sub systems to be thoroughly defined, designed and understood by the entire organization. However the processes may be optimal and truly efficient within its establishment, but if the employees do not

understand the process, do not have the correct competence or if the resources are not placed sufficiently placed, their existence is unnecessary and redundant. As long as the tools and technologies are supporting and created around the already established system in the organization, the potential of providing high level quality is possible (Liker and Morgan 2006).

In addition to the principles described above, McManus (2005) describes Womack and Jones´ five steps to Lean in Table 5. The table displays how Lean philosophy is achieved in the areas of manufacturing and engineering in organizations. This report has already been described as focusing only on Engineering and Product Development Lean accomplishment. McManus (2005) states the five steps as: the specific value of the product, identifying the value stream for the product, establish a flow without interruptions, and that the customer shall pull value from the producer. In that way organizations will manage perfection which is a core principle to provide Lean in product development. According to Womack and Jones (2003) the foundation for attaining the five steps is the understanding and adaption of Lean thinking. By applying Lean thinking, organizations are able to specify value and map actions that provide value in the most optimal order and sequence without interruptions. All identified waste shall according to Womack and Jones (2003), be reduced and transformed into value. Ward (2007) exemplifies the Lean way of working as the constitution of employees knowing what their work tasks are and not needing to ask questions. It is obvious to everyone in the organization what to do and no one needs to tell them. The answer why projects fail and are missing the market is because people do not have the right information at the right time when working.

**Table 5.** Applying the five Lean steps to Engineering, Reference: McManus (2005).

| 5 steps | Manufacturing | Engineering |
|---|---|---|
| Value | Visible at each step, defined goal | Harder to see, emergent goals |
| Value Stream | Parts and material | Information and knowledge |
| Flow | Iterations are waste | Planned iteration must be efficient |
| Pull | Driven by tact time | Driven by needs of enterprises |
| Perfection | Process repeatable without errors | Process enables enterprise improvement |

Problems shall be approached and solved systematically and it is important that all the steps should be reflected throughout the whole organization (Summers, 2011). To reach Lean improvements the use of the following factors can be included: the 5S, the development of a continuous flow, introduction of level scheduling, and Kaizen practicing to continually eliminate waste and to create continuous flow (Summers, 2011). In order to become Lean integrated each step in the process shall be valuable for the customer. Focus on total productive maintenance, and to be adequate and flexible by containing Lean tools and techniques are important (Summers, 2011).

Whilst Swedish car companies usually define terms as processes, e.g. the product development process, Toyota instead uses systems. Their work is built upon four different systems that are linked together and overlap each other. The systems are the Toyota Development System (TDS), the Toyota Production System (TPS), the Toyota Marketing and Sales System (TMSS), and the Toyota Management System (TMS). In TPS the idea is instead of providing processes that the employees have to follow, to let the employees themselves provide plans of their work in the best possible way. It is the employees own responsibility to follow up the previous moments (Holmdahl, 2010).

### 6.3 Quality and Total Quality Management

All costs that occur in order to create customer value to the end product are considered as quality costs. Quality costs can, among others, be prevention costs, detection costs, scrap, re-work and costs associated with unsatisfied customers etc. If these can be reduced without

reducing the value, the resources can be justified to create even more value for the product, e.g. by investing in new equipment (Summers, 2011).

According to Sandholm (2000), quality is how well the customers perceive the product to fulfil their expectations. There are two types of customers, the internal and the external. The external customer is the one that purchases the end product while the internal customer is the one located within the organization. Manufacturing, packaging, storing and transportation are examples of internal customers. They have to be considered as users of the product in the chain. Therefore, there is a need for quality to be secured in all activities throughout the chain when producing the product, from the beginning to the end (Sandholm, (2000).

Quality improvements are not a onetime happening. It is something that has to be worked with concurrently in the organization. In order to succeed to provide continuous improvements, management has to take an active part in the improvement activities and campaign its importance. Even if companies are successful, it is important that they work with continuous improvements at all levels. It is found that people get stimulated when they are part of quality improvement work, but time and resources must be available (Sandholm, 2000).

## 6.4   Methodologies and Tools

Within the frame of Total Quality Management (TQM) there are several different tools that are used. Bergman and Klefsjö (2010) refer to the Seven Improvement Tools: Data collection, Pareto charts, stratification, control charts, histograms, cause-and-effect diagrams, and scatter plots. Three of them are explained below. There are also several methodologies practiced within TQM: Kaizen, Value stream process mapping, 5S, Kanban, Visual thinking, Visual Management, PDCA-cycle (Plan, Do, Check, Act).

### 6.4.1   Improvement Tools

- *Data collection: This tool is o*ne of the most important tools needed and is a basis in order to improve. While, when collecting data it is important to be aware of the problems and what facts are needed in order to clarify the problem.

- *Cause and Effect Diagrams:* Also called Ishikawa diagram or Fishbone diagram. Used in order to find the root causes of a certain problem. The problem is stated and all the main causes to the problem are listed. The evaluator shall list all the causes connected to the main cause which is then structured in a diagram, see Figure 2.

- *Stratification:* It is suitable when data is collected from different sources. The different data is separated and for example illustrated in different histograms, see Figure 3.
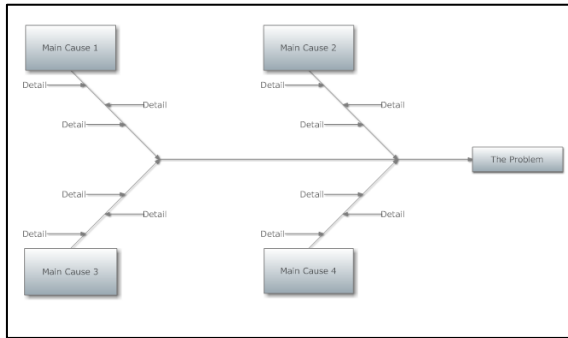
**Figure 2.** Cause and effect diagram.          **Figure 3.** Stratification diagram.
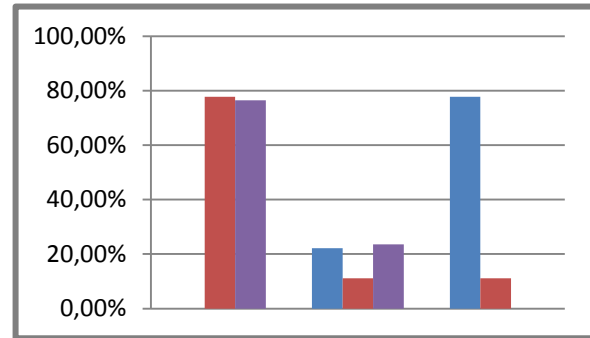
### 6.4.2   Kaizen

Kaizen is a Japanese word, which is combined by the words *kai*, which means continuous, and *zen*, which means improvements, thus continuous improvements. The Kaizen thinking aims to involve everyone in an organization in order to make the company focus on significant details to improve, (Harry et al, 2010). Kaizen is about improving quality, reducing costs and increasing productivity and its guiding principles are: Combine, simplify, and eliminate (Summers, 2011).

### 6.4.3   Value stream process mapping

Value stream process mapping focuses on the value streams in projects and is a technique for identifying value adding and non-value adding activities in the work. Value stream process mapping is described more in detail in section 6.3 Process Mapping (Summers, 2011).

### 6.4.4   5S

5S is a methodology for structuring and keeping order in an organization. It is built upon five words that all starts with an "S": *sort, standardize, set in order, shine, and sustain.* 5S is an important keystone in Lean and is a central method to achieve continuous improvements in the organization. The methodology 5S are not only regarded as a tool within Lean thinking, it should also be regarded as a lifestyle. 5S provides logical processes which applies for the methodology of visual management techniques (Harry et al, 2010).

### 6.4.5   Kanban

Kanban is originally a Toyota tool for the manufacturing area. It was originally a signal card for alerting the next activity to start in the upstream process. It is also known as the pull system, i.e. producing in response to customers demand (Harry et al, 2010).

### 6.4.6   Gemba

Gemba is the idea of visiting the area in which problems occur in order to understand the full impact of the problem (Öjmertz, 2004).

### 6.4.7   Plan Do Check Act – PDCA

Plan Do Check Act (PDCA) is called the improvement cycle and is a tool for how to structure the improvement work, see Figure 4.  It can be applied to processes to plan the work, perform the work, study the work, and in the end find improvements. It can also be used

directly on the improvement work. The steps in the PDCA cycle are described by Bergman and Klefsjö (2010) as:
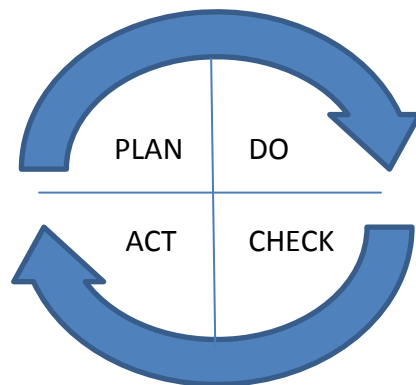


**Figure 4.** PDCA cycle.

**Plan**: The methodology is based on first identifying the causes of the problems. A selection of The Seven Improvement Tools can be used in this step. Failure Mode and Effect Analysis (FMEA) and Design of Experiments (DoE) are other tools that can be used. Sources of errors and variations can be identified by collecting data in order for visualization.

**Do**: In this step the responsible for the improvement work will perform the actual activities of the improvement work that are decided in the plan phase.

**Check**: The outcome of the implementation of improvements is investigated in this step. Several tools such as histograms, Pareto charts and scatter plots are helpful tools in the analysis of the implementation in order to get proper measures of the improvements.

**Act**: Based upon the results from the analysis, actions can be taken. If the improvement implementations are efficient, they can be established in the work mode as the new routines. If the implementations are not sufficient, the PDCA should be performed once again in order to generate new improvements that will give satisfying results.

### 6.4.8   Visible knowledge, Visual thinking & Visual management

The aim of visible knowledge is based upon its contribution towards an increased level of an individual's engagement and understanding. Use of pictures instead of words to distribute information generates a clearer understanding. Pictures, diagrams, curves, physical or visual models and maps are easier to absorb than e.g. tables with numbers (Holmdahl, 2010).

Visual thinking is a methodology that can be used in different areas in an organization with the aim to make information visible. The method is concentrated to enhance people's involvement, regarding improvements identification. It promotes peoples commitment toward discussions about solving identified issues. Consequently, the information will be available to everyone which will generate a view of the organizations position in different areas. It will also endorse empowerment (Holmdahl 2010).

Visual management is rooted in Toyota and is a philosophy rather than a methodology. It is a central part in Lean thinking. The basic idea is that every activity in the process shall be

visible and displayed to everyone in the project, at the department and in the organization. It will enable the planning of future activities that everyone has agreed to.

This way of working can be accomplished by the use of e.g. cards, colour-coding systems and layout designs (Harry et al, 2010). People watching this kind of board should be directly informed about the current status in the project (Red Lion Controls, 2011). According to Mascitelli (2011) the keystone in visual management is the stand-up meetings which act as a forum for sharing information in the team. The stand-up meetings are preferably brief and around fifteen minutes and held in the beginning of the day. However Visual Management is not an idea that can immediately be anchored directly into the organization, it is something that needs to grow through work of improvements and customer focus (Liff and Posley, 2004).

According to Sayre (2009) the use of a task board makes it possible to visualize all the work tasks that are performed by the members of the team. It is important that the board is physical in order to provide information transparency. It is central to keep the board in good shape and maintain it over time (Sayre, 2009).

In order to succeed in Workflow Management the visualization of planned and unplanned work is critical. Interruptions and delays often contribute to new actions of work tasks and they need to be stated on the board in order to provide the project and organization with new solutions. The board should enhance commitment, engagement, and real-time problem solving. The information suited to be visualized on the board according to Mascitelli (2011) are: planned work, work that is not planned but yet has to be done, action plan for the nearest weeks in time, timeline, problem solving, and "parking lot", see Figure 5.
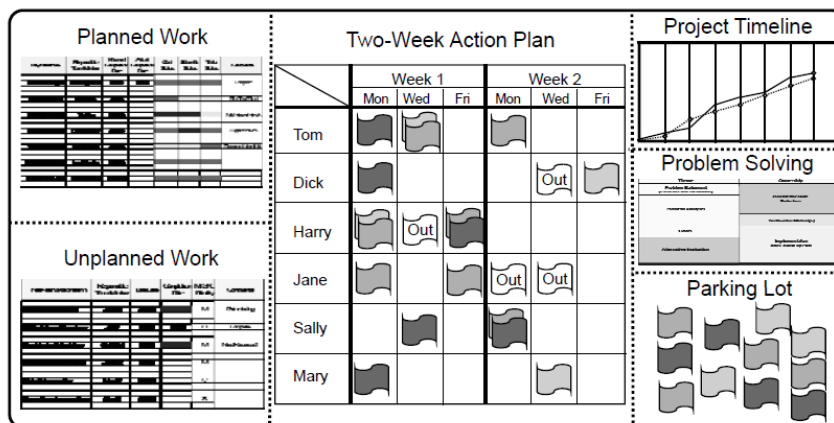


**Figure 5.** Example of a project time board, Reference: Mascitelli (2011).

The information to specify on the board can be diagrams of critical parts in the project, knowledge briefs in the format of A3 problem solving that capture problems that have been solved, and a "parking lot" for issues that have not yet been solved. The team members can at all times place sticky notes with issues that they want to highlight in the parking lot (Mascitelli, 2011).

The board can be designed in different ways, but should preferably have a size of about 1 by 2 metres in order to ensure that it will contain enough space to fit the information needed. An example of the board can be viewed in Figure 6. It is recommended to use a pull down board, whiteboard, or free-standing board (Mascitelli, 2011).



**Figure 6.** Example of a project board, Reference: Mascitelli (2011).

### 6.4.8.1   Improvement Board

There are many techniques of providing a continuous improvement environment. The improvement board is one of them, which enables organizations to illustrate, identify and solve problem incrementally. In that way, the board makes it possible to view the value stream in the work. The PDCA cycle is one core methodology in the procedure which enhances the solving iteration technique. There is no standardized layout of the board, while it is considered important that the board mirrors according to the own organizations procedure and techniques. The improvement board is also regarded as a "mission control" method, while it demonstrates performance breakthrough. The board needs to be updated about once a week, in order to keep information fresh. View an example of the improvement board used at Ruag Space AB in Figure 7 (Maskell & Baggely, 2006).
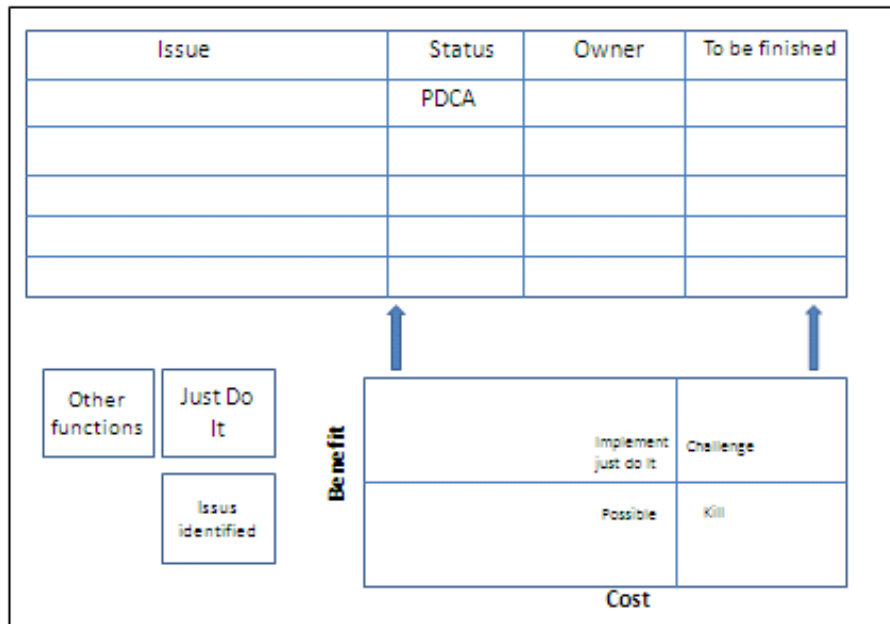
**Figure 7.** Improvement board, Reference: Influenced by Ruag Space AB Improvement Board.

## 6.5  The theory of Process structures

All activities within an organization are parts of different processes. The processes contain different suppliers and customers, which are either internal or external. The input to a process comes from an internal or external supplier while the output is aimed for the internal or the external customer.

Usually organizations are structured and divided in different areas such as product development, manufacturing and purchasing. The processes however, are run throughout all the functions. This can be illustrated in Figure 8, with functions vertically and processes horizontally in the organization.  The functions provide the project with resources and goals while the processes provide the project with structures and methods. This may lead to sub-optimization which in turn results in reduced customer satisfaction since the processes functions are to provide customer value (Sandholm, 2000).

A process can be divided into main processes and sub processes. A main process is a process that refines products or services to an external customer. The main process consists of sub processes, for example lifetime testing, form fill-in and processing. The sub processes consist of activities and the activities consists of work tasks which can be divided into smaller activities or steps (Sandholm, 2000).
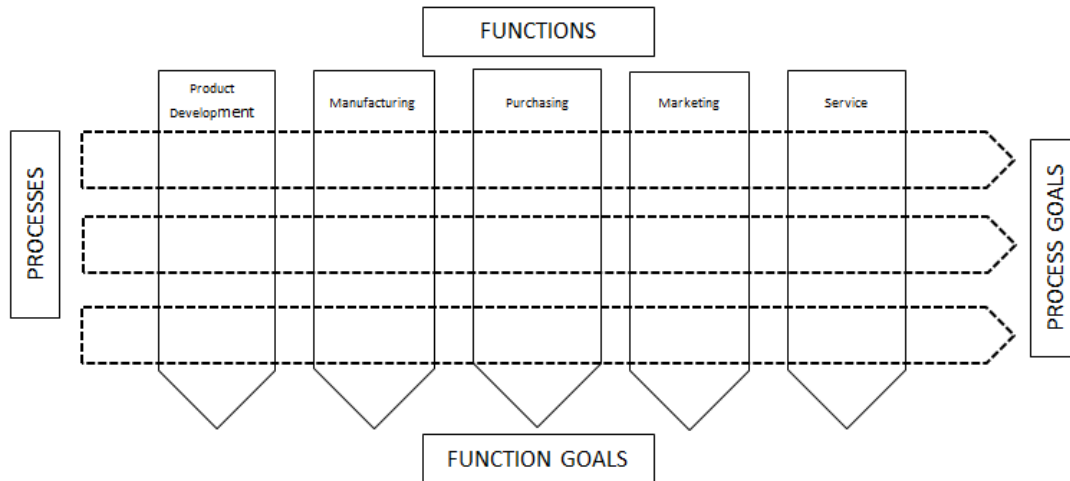
**Figure 8.** Functional organization with cross-functional flows, Reference: Sandholm (2000).

The supplier's role is to identify, learn and understand internal and external customer needs. The supplier responsibility is to make sure that the customers are satisfied with the produced and provided outcome deliveries. The customer in turn shall identify internal and external suppliers and inform them about their needs. How well the customers' demands are fulfilled must be investigated by the processor in order to secure the quality accomplishment. The processor shall also use feedback from the customers in order to improve the activities to provide products that conform with the customers' requirements (Sandholm, 2000).

### 6.5.1   Process Mapping

There are different terminologies used in the context of process mapping. Different authors use different terms when they discuss process mapping methodologies e.g. "Process Mapping", "Value Stream Process Mapping", "Value Adding Process Mapping", and "Metric Based Process Map".

In order to change and improve a company's business, it is crucial to understand the complete process within the organization. By analysing the processes it can be determined to what extent the processes fulfil the business objectives by relating them to customer service, efficiency, effectiveness and profitability. Process analysis can be performed by process mapping methodology which is a way that allows the employees to give their considerations and view of the processes and where these can be improved. The challenges of process mapping are to ensure that the correct and complete view of the process is determined and to visualize it in a distinct way. With a holistic approach the employees can take part in the overall process and get a better understanding of how their work affect the end product. If people do not understand why they are doing the work they are doing, they will not be as engaged and committed in their work (Jacka and Keller, 2002).

### 6.5.2   Value Stream Mapping

According to Harry et al (2010) Value Stream Mapping is the methodology where every step in the process is noted and timed in order to reduce the non-value adding factors i.e. waste.

A value stream makes sure that the product flow to the customers is smooth. It is to encourage the Lean thinking throughout processes by the collection of information and data analysis. It is used in order to reduce costs and promote efficient information flows within organizations. Value Stream Maps show how products, material, or information travels through the different tasks in a process. It is concentrated to map the current state and does not consider variations or process changes over time in the process (Harry et al, 2010). Holmdahl (2010) points out that it is important to be careful when performing value stream mapping in product development since it is a methodology developed for production systems. The process mapping method may seem simple, theoretically. However it is often an eye-opener to managers that think they know their business inside-out.

Process Mapping is a customer driven activity since all involved have to understand the activities that are performed and how they give value to the internal and external customer. Processes that do not provide any value to the end customer do not contribute to outputs that anyone needs or wants. It is therefore central to have the customer in focus in process analysis (Jacka and Keller, 2002).

### 6.5.3   Mapping performance

When mapping a process, the lead times are interesting to investigate. Long lead times do not necessarily imply an activity that takes too long time. If a process is too short there is a risk that it is on the expense of quality, which in turn negatively affects the end product. By combining the process time and the lead time the total time of the process can be determined and the bottlenecks can be identified (Jacka and Keller, 2002).

Harry et al (2010) suggests that the current work flow should be mapped by drawing the main tasks in the process by hand. The process time, cycle time, queuing time (queuing time is delays from one activity to another) should be noted in order to determine the value flow. Sobek [1] suggests to limit the activities in the mapping process to constitute a number of around 10-12 per phase as a starting point.  Main activities shall be described distinctly and shortly and as procedures, actions, and how they are supposed to be performed (Jacka and Keller, 2002). As a second step the main activities are broken down into more detailed level in e.g. a Flow Chart. Based on a brainstorming session the different activities can be stated and put in a flow sequence (Sandholm, 2000).

Process analysing initiates the activity of information gathering and requires structured methodologies to gather data and document information. One approach specified by Jacka and Keller (2002) is to perform the following steps:

1. Identify the process
2. Describe the process
3. Identify process and/or unit owners
4. Interview process and/or unit owners

---

[1] Interview with Durward K. Sobek II, Ph.D., Professor and Programme Coordinator of Industrial Engineering, Montana State University, Bozeman, Montana, USA.

Before the actual process mapping procedure begins the reviewer needs to know the functions that are included in the process and what their respectively work tasks are. If this is not obvious to the reviewer, a Work Flow Survey can be sent out to the people involved in the process 1-2 weeks prior to the mapping interviews. The survey aim is to collect the information needed regarding the employees, such as employee title, tasks, department and a summary of job duties (Jacka and Keller, 2002).

Conveniently the activity steps will be stated across the top of the sheet. The functions or roles involved are then listed vertically to the left. The functions should be stated in chronological order of involvement from top to bottom, if possible. By the use of sticky notes this is quite easy to manage (Jacka and Keller, 2002).

Every action in the process will be delegated a sticky note and the advantage is that they are easy to move around, and re-write if there are misunderstandings during the mapping process. Jacka and Keller (2002) suggest that it is convenient to specify the different colours to correspond to different phases or different employees. Different colours on the pens can make the work easier enable to colour code different activities or steps in the process (Jacka and Keller, 2002).

### 6.5.4   Evaluate and analyse the Process Mapping

When all the activities are stated and sorted they need to be analysed. The level of value that the activities are providing the end product with must be considered. The different factors to analyse are the relationship between value, cost and quality of the activity.  Errors and failures must be identified and considerations must be made based on their level of importance. Activities that are performed with the aim to solve problems and correct errors in the process must be evaluated in order to eliminate the root causes. The analysis shall also cover the use of and need for documents and databases in the activities. This is managed by analysing the level of importance of these factors, how updating is performed, which the sources of information are, and how the information can be used when improving the process (Sandholm, 2000).

## 6.6   Communication

Over the years, communication has been regarded by many experts to be the basis for solution of all problems. According to Richmond et al (2005) this is not so. Communication is a necessity for being successful, but it is how it is used that creates its ability to solve problems. Communication is a process with the aim to transport an amount of information from one person to another. This implies that communication affects people every day in one way or in another, verbally or non-verbally. By the fact that organizations involve human beings and they are affected each day by communication at different levels, it indicates the level of impact that the communication will have on the entire organization, every day. According to Richmond et al (2005) this brings the consequence that communication is a core foundation that will provide a qualitative environment in all organization if it is used correctly. It should be regarded as a tool. While communication does affect people and organizations every day, it is significant to know the level of the current situation of communication. The goal for communication is about three different factors according to Richmond et al, (2005).  It makes it possible to *develop interpersonal relationship, gain*

*compliance and gain understanding.* If one of those three are fulfilled the others are often also achieved.

It is stated by Richmond et al (2005), that the goal is not to increase communication in a quantitative perspective, it is about to increase the communication in a qualitative manner. Increasing the participation at meetings for several hours every day does not bring qualitative information, it could in fact result in the opposite.

When distributing information there are five components that constitute the communication process. The *source* (sends a message), the *message* (the information), the *channel* (in which way the message is distributed), the *receiver* (receives the message) and *feedbac*k (feedback on the message from the receiver). These components contribute to make the communication process complex to control and handle. Telling is not equal to communicating, it is only a small part of the communication process. It is the degree of interpretation that has a huge impact on the communication quality. If distributed information has not been perceived and understood correctly the communicating process is meaningless and time is wasted (Richmond et al. 2005).

Communication can be divided into downward and upward communication. Downward communication is referring to manager's communication to employees at a lower level in the organization and is often regarding work descriptions, rationale, ideology, information and feedback. Upward communication is provided by lower level employees communicating to upper level managers. This process is only effective if managers allow this communication and believes in its nature of quality generation. Information sent upwards in the organization must according to Richmond et al (2005) be positively stated. If too many negative statements are distributed the intended outcome can well become the opposite. The formal network in the organizations that constitutes the communication procedure must be mapped out. This sets the basis for being able to improve the communication in the organization.

In order to establish a qualitative communication, a plan of achievements must be specified and stated. Different functions are able to express their need for communication to provide an efficient work. The communication plan will act as a foundation for the communication and information distribution. The plan is recommended to be updated around four times a year and aims to support project participants' interaction and communication with each other. The different factors to state are:

- Communication
- Purpose
- Audience
- Author
- Communication location
- Frequency

Table 6 illustrates an example of a communication plan execution.

**Table 6.** Regular and on-going communication (Develop Your Project Communication Plan), Reference: Collegiate Project Service, (2007).

| Communication | Purpose | Audience | Author | Communication location | Frequency |
|---|---|---|---|---|---|
| Monthly status report to campus executives | To keep the senior leadership of the campus informed of the project's progress and key upcoming activities. | • Executive sponsors<br>• Steering Committee<br>• Executive Committee<br>• Computing Advisory Groups | Project Manager | Email to list<br><br>Post on project website | Monthly |
| Weekly schedule metrics | Monitor and report progress on scheduled tasks.<br><br>Troubleshoot problem areas and solve or elevate issues as appropriate. | • Project management team<br>• Steering Committee<br>• Others, as appropriate | Project Manager | Email to list<br><br>Posit on website<br><br>Steering Committee | Weekly |
| Project team calendar | Keep project participants aware of key project dates and to help them manage their schedules.<br><br>Maintain training calendars. | All project participants (project management team, steering team, university community). | Project Coordinator | Post in project folders | Updated as needed |

This plan will reveal the need for increased or decreased communication in an organization. People involved in projects will refer to it and be able to plan their work based upon it. It will determine those specific factors that are significant for establishing and securing that the organization provides a qualitative and consolidated communication in projects.

In the quest for providing a qualitative communication environment the need for determining the current situation is critical. In order to perform a communication plan the capacity of the organizations possibilities must be known. The knowledge is gained by performing a communication audit that includes three steps. The first is to get to know the critical strategic communications strategies. It involves three categories of strategy (vision, targets etc.), implementation (effective materials, train messengers) and support & alignment (sufficient resources and inform staff at all levels). The second is to identify

different levels of practice. This involves the maturity scale of the current situation of the different communication practices. They are divided into five levels, starting with the lowest level of maturity: Ad hoc (1), planned (2), institutionalized (3), evaluated (4) and optimized (5). The third step is to assess current performance and capacity. It involves evaluating the current communication and identification of the organizational capacity by using the data collected in step two (Coffman, J., 2004).

## 6.7 Interviews and surveys

There are several different methods to collect data and information according to the literature. Some of these that are convenient to use in the context of improvement work and process mapping are explained in the next sessions.

### 6.7.1 Interviews & Focus Groups

Interviews are used in order to explore attitudes, emotions, assumptions, perceptions and the thinking of how people's behaviours are affected. In order to investigate areas that have been identified as critical in an organization, in-depth interviews can be performed and are an effective way to collect significant data. Interviews are also convenient to use for following up results and confirming interpretations from earlier data collection.

Interviews are conveniently conducted in the customers' environment and usually last one or two hours (Ulrich and Eppinger, 2008). They should be well prepared, focusing on the right questions that are related to the topics being investigated. The approach, questions and the interaction between the interviewer and the interviewee are essential in perspective of the result outcome. The interview questions should be based on their level of magnitude contents in relation to the interview time. The interviewee should be properly introduced to the interview objective and purpose (The University of Sheffield, 2012).

According to Jacka and Keller (2002) the moderator of an interview should always start the interview with open questions, in order to make the interviewee feel comfortable. The body language of the moderator and being a good listener plays a central part in how comfortable the interviewee will be. The interview should be more as a conversation with engagement than just a strict interview. Throughout the interview the moderator must remember to follow the scope and objective in order to collect the data of interest (Jacka and Keller, 2002

Focus groups are used initially to get an idea of individuals' attitudes and views and are sometimes used as support when designing and formatting questionnaires. It is a well-structured method to discover customers concerns and to test new concepts. A disadvantage is that the sample might not reflect the entire population (Harry et al, 2010). The method is based on discussions of a couple of hours with 8 to 12 participants controlled by a moderator. The moderator is usually a market researcher but can also be one of the team members (Ulrich and Eppinger, 2008).

### 6.7.2 Evaluate interviews

When interviews have been performed in the purpose of collecting relevant data it is essential to have a proper methodology for analysing the outcome. Depending on how the interview analysis is organized and structured the level of how well people will embrace it will vary. The balance between the interviewee's description of the answers and the

interviewer's interpretation of the answers is vague. This is an important factor to consider when analysing the interview outcome (Kvale, 1996).

**The six steps of the analysis:**
Kvale (1996) has stated six steps that are important in the analysis of the data collected from interviews. The first three steps are also important to consider while performing the interview.

1. The interviewee describes the world as he/she perceives it.
2. The interviewee discovers new relationships during the interview.
3. The interviewer interprets what the interviewee says and "sends it back" to the interviewee in order for the interviewee to have an opportunity to confirm that it was correctly understood.
4. The result from the interview should be structured accordingly:
   a. Structuring the interview material in order to be able to analyse it in a proper way.
   b. Clarifying the material by e.g. removing less essential parts in order to be able to analyse it.
   c. Meanings are developed by highlighting the interviewee's view and by providing new perspectives from the interviewer.
5. An additional interview with the interviewed person for clarifications.
6. Act upon the outcome of the interview. This can be done together with the interviewee based on the knowledge gained from the interview (Kvale, 1996).

**Analytical questions**
The interview result that will be analysed has different characteristics that have to be considered. Knutsson (2008) lists questions that are convenient to ask to the collection of interviews:

1. What questions do other researchers ask regarding this type of material?
2. To what extent is the interviewee's argumentation relevant?
3. To what extent is the interviewee's argumentation consistent throughout the interview?
4. To what extent is the interviewee's argumentation logical and sustainable?
5. What is perceived as the problem(s)?
6. What is perceived as the cause(s) to the problem(s)?
7. What is perceived as solution(s) to the problem(s)?
8. What does the argumentation say about the interviewee's honesty?
9. What does the argumentation say about the interviewee's agenda?

### 6.7.3 Surveys
Surveys or questionnaires are efficient to use when a large amount of respondents knowledge, attitudes and/or other conditions of individuals are required.  There are several survey methods: face to face, internet, telephone, directs observation, mail, or email. [(Harry et al, 2010) and (Ejlertsson, 2005)].

**Face-to-face interviews:** Face to face surveys are suitable when the questions are of a character that the respondents will likely have difficulties to answer with other methods. The drawback is that it is the most expensive approach within the survey methods.

**Telephone:** It is a quick way to gather data from a relatively large amount of respondents. The script should be prepared where the respondents' answers can be filled in.

**Mail**: Mail surveys are a cost effective method to collect answers from many respondents. A drawback is that it is difficult to get more detailed information from the respondents.

**Email**: With Email surveys answers from many respondents can be collected, and a further advantage is that the answers can include pictures and sounds. Email surveys have the drawback of not being able to bring detailed information from the respondents since you do not have the possibility to ask for clarification if the answers are not sufficient, (Harry et al, 2010). When performing a survey it is according to Ejlertsson (2005) significant to follow an approach of how it will be accomplished.

### 6.7.3.1 *Considerations when constructing a survey*

One keystone when performing a survey is to have a clear purpose of why in the first place the survey is performed. According to Ejlertsson (2005) there are several rules to follow when establishing a survey. It is of utmost importance to be aware of what the opportunities are in perspective as an issuer of how to interpret the different answers from the surveys. The different points to consider when constructing the questions in a survey are several. The questions must be unequivocal and have the right level of simplicity in their texture. The questions must not be leading, too long or formulated in a negative way. When constructing the questions there must be a carefulness of the degree of only stating yes and no questions. These different factors are according to Ejlertsson (2005) important to evaluate before establishing the final survey questions in order to secure both quality in the answers as well as in the end result.

The variable scale and measuring scale can be divided into two different types of variables: quantitative and qualitative. Quantitative variables are numerical values and qualitative variables are non-numerical value and imply a classification of the answer frequency.

A main factor when using surveys in a research study is to ensure that the final result is qualitative reliable and representative for its actual purpose. There are many factors according to Ejlertsson (2005) that can affect the end result. It is therefore important to have a structured process to follow, as illustrated in Figure 9. Defects can otherwise be rooted if the right questions are not stated, if the survey is distributed to the wrong population or if people refuse to respond. Ejlertsson (2005) points out that the terms validity and reliability are the two main factors that must be thoroughly considered in order to ensure the survey quality. Validity means the ability to measure what it intends. The aim is to construct questions that have high validity in order to systematically eliminate the errors. This implies that the terms used in the questions must be uniformly defined and understood by the respondents. High reliability is a factor to aim for if high quality results are requested when performing a survey (Ejlertsson, 2005).

### 6.7.4 Evaluate surveys

Evaluating the answers from the survey is a major part of the survey performance and an important part according to Ejlertsson (2005). There are different methodologies when structuring the answers from a survey. Answers from open-ended questions should be categorized in the best optimal way by searching for terms and specifications that are related and have a common denominator. Open-ended questions are regarded as "soft data" by Ejlertsson (2005), meaning that they are important to consider but that they do not have the same quality aspect of reliability and should be considered as additional information to the other questions. The internal loss of the survey is also a critical factor that must be regarded before evaluating the result. That number could have a major impact on the end result. A frequency table should also specify the number of observations performed. Diagram types as bar graphs are formats that visually present the results based on the frequency table. If an evaluation and a comparison are determined to be valuable to perform between subgroups in the survey, a statistical analysis can be performed. The aim is to evaluate the probability that the differences of the answers between the subgroups are randomly stated or if they are reality based. One issue with using survey methods is to get all the receivers to answer the survey Ejlertsson (2005).
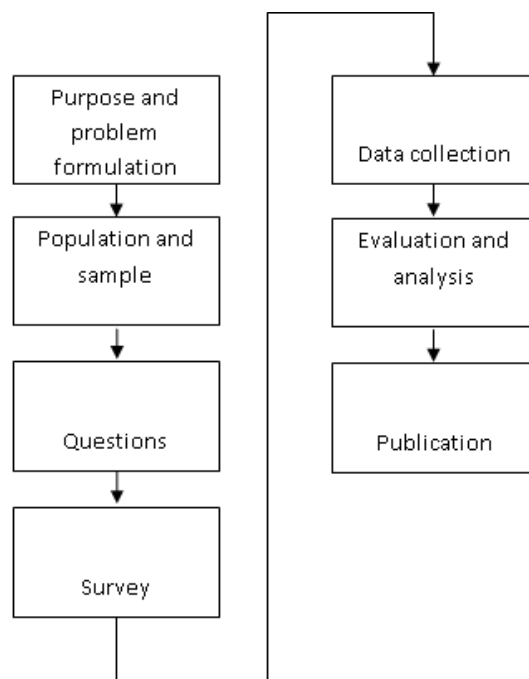
**Figure 9.** Survey performance, reference: Ejlertsson G., (2005).

# 7   Benchmarking

Achieving blameless perfection in an organization is more wishful thinking than a realistic goal. However, striving towards perfection is no easy task since it requires qualitative and distinct strategies. With the quest to all the time improve and follow the strategy it is manageable to become top best. Benchmarking is a tool that makes it possible for an organization to find the improvement opportunities needed in order to become the best. According to Bergman and Klefsjö (2010) there are four different benchmarking methodologies: Internal Benchmarking (comparing different areas within the organization, for example department to department), Competitive Benchmarking (comparison and identification of gaps between the own organization and competitors), Functional Benchmarking (Comparison of the own organization with the best organization within the same activities and area) and Generic Benchmarking (Comparisons with non-competing company that are known to have best practices in a specific area). The Benchmarking methodology will according to Bergman and Klefsjö (2010) result in the search for best practices that will lead to superior performances. When an organization wants to improve in a specific area they can do so by adopting the benchmarking method to evaluate other companies' successful stories. In this project the Generic Benchmarking methods are selected and performed accordingly.

Bergman and Klefsjö (2010) emphasize that benchmarking is not at all about copying other companies' way of working. It is about catching how other organizations have succeeded in a certain area to evaluate the key success factors that put them in that position. It is about researching the company´s processes in order to identify the best practice to improve the performance in the organization. It is significant to adapt the information gathered from the benchmarking into the own company culture and operations and to put it into the organizations own context according to Bergman and Klefsjö (2010).

## 7.1   Introduction

The purpose of this benchmarking was to find out how other organizations in other industries are working with the Lean concept in the administrative environment with focus on the product development area. Volvo Group Trucks Technology is at the moment working with a programme called RnD30 (which has been described in chapter 3.1) with the aim to reduce lead times in the product development. Lead time reduction is a keystone in order to perform more efficient work in the processes to increase the use of the effective time of the employees operations. The quest at Volvo GTT to become more efficient in their operations with focus on quality related issues enhances the aim of this project of how to become more Lean oriented. Interesting questions to explore in the benchmarking are why the companies started to work with Lean in the first place and in particular in what way they did it. What were the key factors for success? Based on the data collection the purpose was to form the findings from the benchmarking into a context that would suit the department of FVV and Volvo GTT. By gather information, examples, and reality based facts from other organizations that have succeeded in the Lean area, recommendations of Lean working methods to achieve Best Practice and to solve identified problems at Volvo GTT will be established. The findings have been used as influencing factors for the creation of the Lean recommendations.

The method of the benchmarking activity was defined by Bergman and Klefsjö (2010) approach which is based on six steps: plan, search, observe, analyse, adapt and improve, see Figure 10 below.  In the plan phase it is of utmost importance to critically evaluate the current situation in the own organization. Look into what does not work today, what does work, what is the goal with the benchmarking and what is expected from the result. In the next step it is about looking into what areas the organizations are successful, and what can be learned from those companies. The next phase is about observing how the organization enables their successful performance. In the analysis step it is about to evaluate why there is a gap between the own organization and the investigated organizations. What are the main factors that constitute their successful story? Analyse what areas can be changed in the own company. Based on the analysis the next step is to look into what can be adapted and how to use the knowledge found within the own organization. The improvement step is about how the implementation of the new changes can be performed.
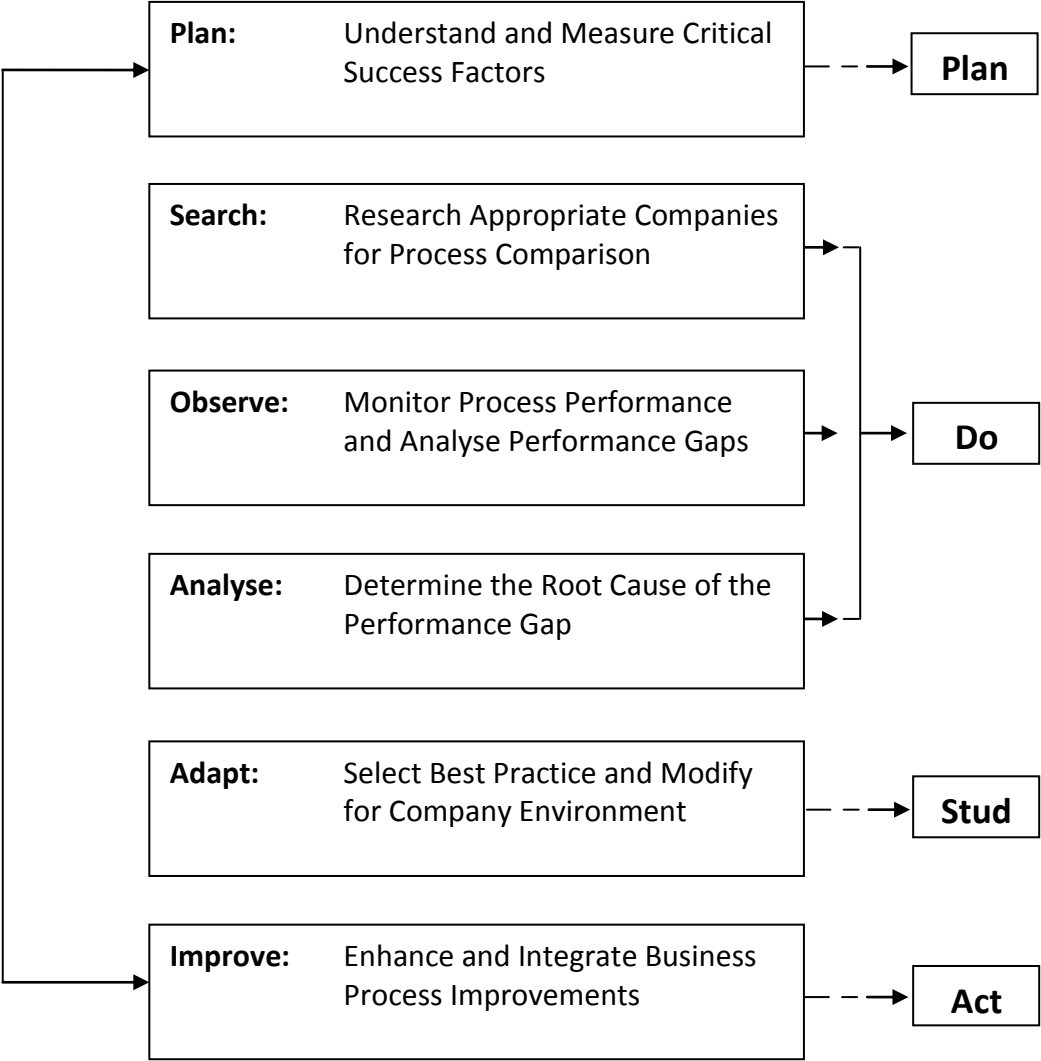


**Figure 10.** Benchmarking process, reference: Bergman & Klefsjö, (2010).

### 7.1.1 Plan

The result will be a foundation for suggested improvements in the way of working in the feature area at Volvo GTT.

The critical areas identified in the Feature Leaders operations and related processes (which are collected from the result chapter 9) have indicated the need for a benchmarking study.

- People are not aware of what their actual tasks are.
- People perform tasks which other people have already performed.
- People are not sure where specific information is located in the Team Place intranet.
- People are not informed about specific information regarding their work.
- People are inconsistent within projects about where they are in a time and task perspective.
- People do not have a complete view of a project.
- People are not aware of other functions tasks.
- Some people do not delegate tasks as they should (do not have the trust in others).
- People do not know who the owner of specific processes and documents is.
- People are inconsistent of how different processes flows should function.

The interviews performed have been based on certain questions that worked like guidelines during the interview sessions. The questions have been formulated based on the foundation of what is interesting to explore in other organizations. The questions asked to the companies can be seen below.

*The guideline questions:*

1. When did the company start working with Lean?
2. When did the company start working with Lean in the area of Product Development?
3. Why is it important to work with Lean also in the area of Product Development and not only in the Production?
4. How did the company implement Lean in the Product Development area?
5. What is important to consider when implementing Lean methodologies?
6. What are the key factors for succeeding in implementing Lean?
7. What are the key factors to ensure that the Lean modes of operation will continue to be-very valuable?
8. How to get all the employees along with the new thinking? How are you working with Change Management?
9. How should Management work to ensure that the employees in the future will continuously work with the new Lean thinking?
10. What are the main difficulties when starting to work with Lean?
11. Do you consider Lean to be for everyone?

### 7.1.2 Search

The companies that were selected to be part of this benchmarking study were Volvo Car Corporation and Ruag Space AB in Gothenburg and Ericsson Borås in Borås. They were

chosen on basis of their expertise within the Lean area. They have all been successful within Lean implementation and/or execution and have therefore been evaluated to be good representatives of the benchmarking process.

### 7.1.2.1 *Volvo Car Corporation*

The person interviewed at Volvo Car Corporation (VCC), was Mr Attila Fükila - Project Manager and Lean Specialist at the department of Purchasing STA Lean Deployment. He is working with the physical processes as a support function of improvements.

Volvo Car Corporation has been working with Lean in their purchasing department for 10 years, but started earlier with Lean in the manufacturing area. During the Ford era, Lean was a main subject and the focus was mainly on Lean implementation within Volvo Car Corporation.

Why Lean in the administrative environment is an important thing to adapt is according to VCC the potential that it provides to decentralize the organization by focusing on involving everyone and let the employees be accessorial to the organization´s business development. A Lean way of working leads to empowerment, which is a crucial factor in order to spread creativity and to achieve that the employees get the possibilities to actively affect the work in the organization. According to VCC it is of utmost importance not to kill people's creativity regarding new thinking and ideas about new ways of working. It is significant that the employees get the notification visually or verbally and that actions are taken to identify possible issues within the organization. It must be ensured that nothing falls into oblivion. Management must consent and encourage the employees to share ideas about how the work mode and environment in the organization or at the department can be improved.

Management engagement is therefore an essential part in order to perform Lean implementation in an optimal way. It is important that the management has the knowledge needed about the Lean area and supports the work in full action. It must consider the Lean work truly important for the organization and the employees' strive for continuous improvements. The employees will feel confidence in the management and take the new ways of thinking seriously if the management is well Lean knowledge oriented.

VCC believes that the 5S model is an important tool in the quest of Lean thinking. If there is a standard format on how "we" are working and how the work is structured, there will be a higher quality of the orderliness in the work place. People will be familiar with how working stations are designed.

A model VCC is working with and also at the moment developing is the Continuous Improvements Boards. The aim is to visually gather the employees' thoughts and ideas about improvements officially at the own department. The purpose is to gather the people working in a group once a week to exchange their ideas of how to continuously improve different areas. It is the people within the group that decide how and when the problems should be solved and if needed bring the problem up to the management level if they cannot solve it within the group. The group should put identified problems on a pick chart in a perspective of benefit to the organization and cost for the organization. The issues are stated on a whiteboard which is always visible to everyone and the issues are always

traceable. Management on a higher level should follow up the statistics of how well the group has solved identified issues in order to ensure that the problems are always taken care of and solved. VCC considers it important to start up this kind of project as a pilot project to test, verify and validate that the model suits the own department and organization.

Change Management is an essential part to focus on when making changes in an organization. Not everyone likes changes, and people often dislike to be affected by a change. According to VCC, it is important to get everyone on the boat but also to accept that everyone does not like to be part of it. It is significant all the time to count the change resistors in and hopefully, eventually, they will accept the change as well.

At a presentation about organizational changes held by Mr Per Davidsson, Mr Fükila learned the importance of letting the employees take part in the planning of modifications in the organization before they are implemented. Management often research about a specific area for years to deeply comprehend why the changes are important. When the new mode of operations is implemented the employees are not given the time they really need to get introduced to and understand the importance of the changes. This example is illustrated in Figure 11.
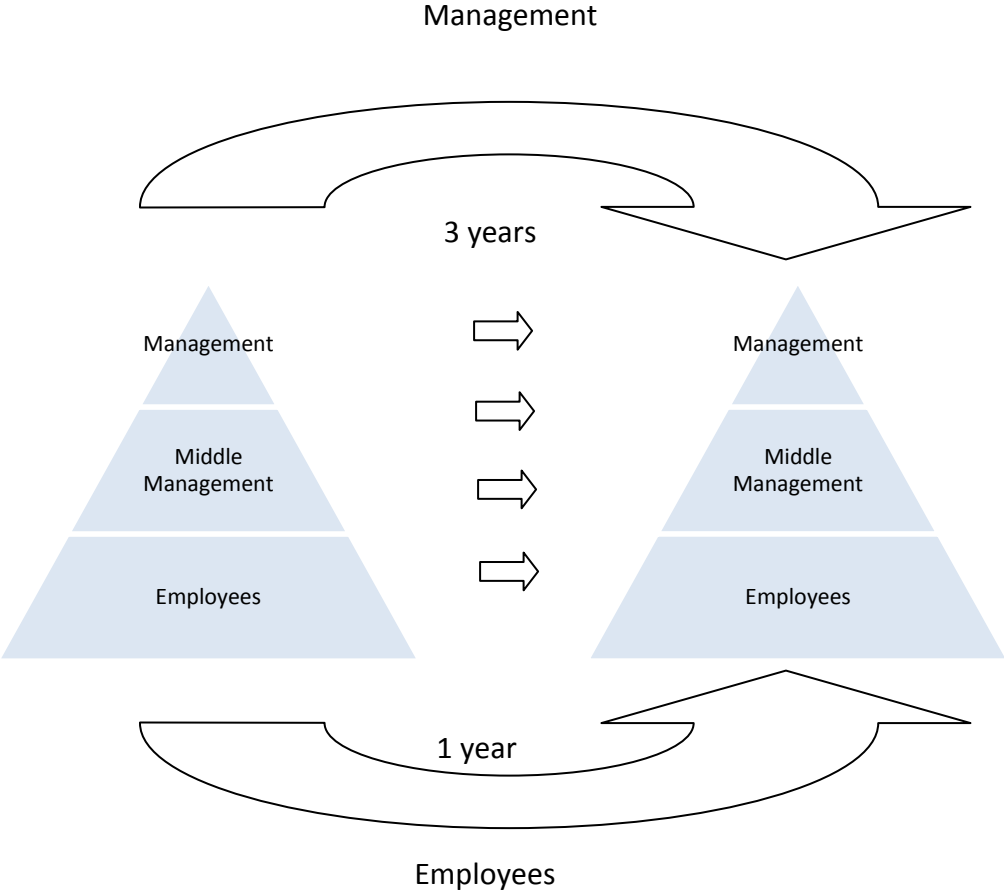


**Figure 11.** Implementation process, Reference: Mr Fükila, A., VCC, Davidsson, P., (2012).

**VCC recommendations when implementing Lean thinking into the own organization:**
- Do not do everything at once.
- Educate a number of voluntary people in green belt
- Start with one tool.
- Start with one group, one area and one project.
- Do not rush.
- Make it simple.
- Do not strive to make it perfect the first time and do not force it to be perfect the first time.
- Be very careful to distribute the information needed for the employees, focus on education and knowledge.
- Do not limit to one solution, make continuous improvements.
- Give feedback to the people around.
- Dare to make mistakes.
- Visualize the work physically.
- Always make small changes, much easier to go back if the result did not turn out optimal.
- Better to take many small steps than few large steps.
- When measure, make sure that the right things are measured and choose numerical values carefully.
- Do not forget Customer satisfaction.
- Delegate responsibilities.
- In order to succeed there must be a wholehearted engagement in the overall work.
- Better to solve 80 % of the problems quickly than 95 % of the problems slowly.
- Spread information during the project about what it is about so that everyone is aware of what is going on.

### 7.1.2.2   *Ruag Space AB*

The person interviewed at Ruag Space AB was Mr Per Malmborg – Operations development and Lean Manager. He has been working with business development for 8 years and has the philosophy that quality must be impregnated in the company to provide optimal results.

Lean was at first implemented in the Production area at Ruag Space AB and generated good results. A part of the Lean concept was at first duplicated from the production by the Design Engineers into their mode of operations and they started to work according to Lean in some areas. Master thesis students performed projects within the Lean area of how to implement Lean in the Product Development in the organization. Managers at different departments studied courses in Lean at Chalmers University of Technology. In 2004 Ruag Space AB started with a generic Lean implementation for the overall organization as an improvement programme that lasted for three years.

The first part to consider when starting to work with Lean is to have consensus within the company on the main values and principles of the organization. That is in order to catch the most essential parts of the Lean thinking. Based on the values and principles the organization is able to establish what tools and methods that will be used in the work, which ensures that the tools and methods will support the values and principles, see Figure 12.

According to Ruag Space AB this model will be the foundation for the Lean implementation, and in future work it will be a support to ensure that the proceeding work is on track.
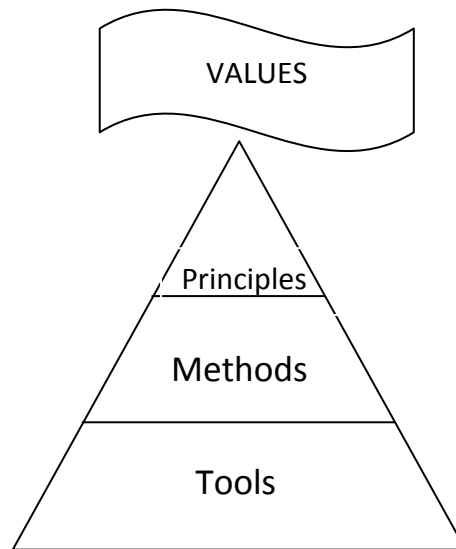


**Figure 12.** Lean thinking structure, reference: Malmborg, P., Ruag Space AB, (2012).

According to Ruag Space AB it is of utmost importance to respect the areas to change or improve when working with implementations of new methods and new ways of working. Without respect, the result of the change can never be optimal. In a management perspective it is important to be aware of and understand that the employees that will be affected by the change need time to get introduced to it. The time it takes for the managers to reach a specific level of knowledge and understanding of a subject, as long time is needed also for the employees to develop a thorough understanding. This is in some organizations not considered and might cause a lot of damage in a quality and time perspective. Changes take time and some of the factors of this phenomenon are that people in general need time to get accustomed to them.

Ruag Space AB regards the importance of distinguishing between the definitions of leadership and chiefdom. An organization needs both but for different purposes. A leader is supposed to coach, educate and lead the people in the group while a chief is supposed to direct and determine what actions to take. Decentralization and self-management is very important for the establishment of an effective organization but the work must also be carried out in accordance with that. A natural way can then be to create several systems within the organization that are directed to the same purpose, but in different ways.

Ruag Space AB is working with the tool Improvement Board. It is implemented at all sections and groups in the organization, including the CEO. Each group has selected a Lean mentor who is responsible for the improvement board and to chair the meeting. The Lean mentor has volunteered to the assignment: it is important to choose a mentor who is passionate about the topic. It is also important that the Lean mentor is not automatically the group manager unless the group manager has volunteered. The improvement board shall be

physical - not in the computer, in order to create the feeling of unity in the group and that everyone visualizes the information the same way and takes part in what is written and stated. All ideas must be taken care of and all ideas must get an answer. No one should feel excluded and no ideas should be excluded without a discussion. The improvement boards include a pick chart where all the problems/ideas are stated in relation to benefit and cost for the organization. It is the employees themselves in the group that state the problems and ideas and decide on their locations on the pick chart. All performed improvements and solved issues are saved in a specific forum/database which enhances traceability.

Audits are performed in order to control and to ensure that the work with the improvement boards at every function runs well. Each year different Lean mentors from the groups meet and evaluate each other's performances in order to secure that the focus is correct and the work is proceeding well according to its purpose. A yearly survey is also sent out to the employees to catch their considerations about the proceeding Lean work. At Ruag Space AB the CEO once a year clarifies the importance of the quality work to the employees in the organization.

Ruag Space AB is also working with continuous value stream mapping in the Product Development. However, process times in this perspective are according to Ruag Space AB not of importance, it is the information flow that is critical to look into. When analysing the documentation distribution, the organization is able to evaluate the flow. The organization is then able to perform improvements and eliminate activities that are not bringing any value to the organization and/or the end product. The value stream mapping is performed by a set of people evaluating every document and activity that is transported throughout a project. Step by step the documents are thoroughly evaluated. The evaluator gathers two people from two functions where the persons, one by one, will explain how they perceive the quality of the documentation and the work they receive from the other function. In that way quality related issues can be identified immediately and probably solved. Ruag Space AB is also working with value stream mapping as a method to track a specific requirement throughout a project in order to discover how the requirement is distributed and what documents are used, all in the quest to improve.

Ruag Space AB exemplifies the importance of knowing and having an optimal process flow in the organization with a football game. When playing soccer the player must have the correct overview of the team, and be aware of the partners' positions in order to set the most optimal flow from the first to the last player to be able to finally score. This example also mirrors how an organization must work in order to contribute to optimization of quality in the work flow.

Ruag Space AB has established a "Wikipedia" forum on their intranet, which is located outside the business system, where the employees can find descriptions of various "good to have" information. People are able to blog about a specific area and/or document information that could be of benefit to others.

An important procedure that has been well-established in the organization is the KIVP (Knowledge Innovation/Visible Planning) structure. It is a board that is used to plan the daily work. Every day, each work group meets for 10 minutes to one by one state the next

activities that they are about to perform in the project looking into both short term and long term future activities.

**Ruag Space AB recommendations when implementing Lean thinking into the own organization:**
- Support from Top Management is an essential factor for success.
- Let the CEO introduce a change to the entire organization in order to create commitment.
- It is important to have a programme to follow when implementing Lean philosophy and to follow up the activities performed.
- Work with Change management.
- Lean is a source of inspiration.
- It is recommended to read Lean literature.

*Ericsson AB*

The person interviewed at Ericsson AB in Borås was Mr Boban Ivanovski who is a Process Manager within Improvement Management.

Ericsson Borås started in 2005 to officially work with Lean in a more organized manner and has ever since focused a lot on how to work according to Lean at all levels in the organization.

**Considerations when implementing Lean**

It is according to Ericsson Borås important to take small steps when implementing new structures and ways of working. This strategy also makes it possible during the pilot project to evaluate what works well and what works less well. Mr Ivanovski points out one keystone of how to succeed in both the initiation and the continuous work of Lean. It is about weaving in the Lean thinking into the organization´s foundation. A company can never succeed in this area if they just copy the methods and models from the Lean books. The organization must evolve in terms of culture, thus comprehending and mirroring the quest of wanting to be more efficient in the work processes. The first rule of thumb when starting to work with Lean in the organization is to have a picture of the entire organization and understand the contents of that picture and have that view and knowledge together as a team.

When an organization wants to start working with Lean, it is important to create a foundation structure. It implies to specify what the organization wants to achieve with Lean, what are the main values, principles and goals of implementing Lean. It will act as a platform to visualize the organization's orientation of Lean thinking and to ensure that the entire organization is directed towards achieving common goals.

**Continuous improvements**

Ericsson Borås considers the importance of creating transparency throughout the organization as a significant factor in the quest of establishing continuous improvements. The work must start at the bottom, meaning the lowest level in the organization while being

strongly supported by the top management. The processes and ways of working should be defined on a general level from a Lean perspective, and thereafter broken down to group and individual levels respectively. In that way the knowledge can be dispersed within the company. This way of working also makes it possible for everyone in the organization to strive for same goal, which is a strong success factor in the Lean implementation. In such a change management process it is of immense importance that people are being continuously coached and supported in terms of Lean by the leadership. That is also to ensure employees' understanding of the value of the changes and why the organization is actually performing these changes.

Ericsson Borås has during their work realized that it is often not the processes that create the problem, it is that people seldom are able to reflect on what they are actually doing in their work tasks, which hinders the possibility of continuously improving the business. Using Lean, Ericsson Borås is ensuring an improvement culture, a platform for the employees to be able to continuously reflect and influence their ways of working. To work more decentralized is a very important aspect in the quest of becoming more Lean oriented. The company works with Improvement Boards at all levels. Each improvement group works with the improvement board on a daily basis and the meeting is held by an elected improvement leader who drives the team's improvement work.

The issues or improvement ideas identified at the meetings are often solved and carried out within the group, otherwise the issues are elevated to the local management group that meets once a week to discuss on a higher level the problems not solved by the improvement group. At the local management meetings the issues are prioritized, cost analysed, and controlled. Issues on a higher organizational level are elevated to the middle management meetings which are held normally once a month. Ericsson Borås works with the Six Sigma tool DMAIC (Define, Measure, Analyse, Improve and Control), which is a structured way of carrying out improvements. The improvement board is fixed locally in the working environment and visualized officially for the entire organization.

**Principles within Lean thinking**

The areas below are considered by Ericsson Borås to shape the Lean thinking in addition to the company's values:

- Customer focus
- Collaboration and Leadership
- Elimination of waste

These areas shape the way each and every employee should see the work environment, in order to be able to contribute in the improvement work.

A principle called "Right from me" is a significant part in the work at Ericsson Borås. The model is established in order to continuously secure quality in the input of every worker, at every step of the process. By ensuring holistic view over the working processes and coming together to terms of how the work should be carried out, as well as following these terms, the organization makes sure that it is almost impossible to 'do it wrong'.

The four principles below are areas Ericsson Borås consider as very important in terms of 'acting Lean' and they are working continuously to impregnate into the organizations way of working.

- "Right from me"
- Standardized work method
- Demand-driven supply
- Continuous improvements

Finally, according to their lean model, the final area is called Operational Excellence, as something the organization is striving after from a Lean perspective, by practicing the aforementioned areas.

Ericsson Borås points out that an organization can never provide optimal quality performance if it does not believe in the method that it wants to use. It is also important not to think that the organization will be Lean just because it uses some of the Lean tools. A proper practice of Lean is about using the right tools in the right circumstances to achieve right results if one strives for excellence, otherwise it is meaningless. And, in order for that to be achieved, the right Lean mind-set must be in place.

The employees are continuously educated in the areas of the Lean system through The Trainer concept. A Lean Maturity Tracker is used as a tool supporting the improvement groups in the Lean journey, as well as for self-assessment. The latter is controlled and supported by official assessors in the organizations, who support the groups in the Lean journey as well as assess and recognise the maturity level in their Lean journey.

**Perform the changes**

Change Management is an important aspect when implementing Lean within the operations, i.e. a system which requires a long term commitment by everyone and that strives for excellence and continuous improvements. There are some factors that one needs to consider in this respect. Firstly, the improvement leaders and lean drivers need to be 'hand-picked' as they should be managers of change. There are among others three factors that must be thoroughly evaluated before presenting new changes to the employees. First of all, the person nominated to present the new way of working must be passionate about the topic. Secondly, the changes must be visualized to the employees by showing examples and experiments. Thirdly, the person that is implementing changes must know the employees and needs to be personal and interested in the people around him/her. Within the Lean implementation, commitment must exist. Management must be fully committed, knowing what motivates the employees and thoroughly pointing out why the change is important to each individual. At last, Ericsson Borås pinpoints that one cannot have a universal approach to Lean implementation, but the approach should be adjusted to the context in which the department/group works in.

**Ericsson Borås' recommendations when implementing and working with Lean:**

- Work in small incremental steps
- Lean is not only about tools and methods, but it is in great deal about culture and philosophies
- Lean has to be practiced with learning-by-doing and cannot just be studied through a Lean book
- Lean implementation must be moulded according to the specific context and culture
- Communication is essential
- Meet face to face, improve on the 'place of the action'
- Ask why until there are no why's left in everything you do

### 7.1.3 Observe

The information gathered during the benchmarking study at the different companies has resulted in different significant factors. It clearly appears that there are several levels of work modes regarding quality related issues between the organizations. Ericsson AB and Ruag Space AB have for many years worked according to the Lean philosophy and have performed successful results in the quest of all the time working to become superior. Volvo Cars Corporation is at the moment working to implement a Lean way of working in projects and has all the opportunities to succeed based on the knowledge and thinking that they have within the organization.

Volvo GTT has a very limited Lean culture in the area related to feature work. The main factors that are considered as critical and not fulfilled in the feature area today are according to this Master Thesis work:

- Let the employees be part of the improvement work.
- Let the employees themselves identify and solve the problems.
- Follow the standardized processes better (operationally and with documents).
- Quality must be impregnated into the organization.
- Values and principles of how to achieve quality in the work must be stated.
- Focus on decentralization.
- Continuously map the current state.
- The employees must get the knowledge and views of what/when/how other functions that they are working with are performing their tasks.
- Correct from me.
- Creating transparency from bottom to the top.
- Solve the problem first, instead of adding and implementing new activities in the quest of solving the existing problems.
- Use terms that cannot be misunderstood and that everyone understands.

### 7.1.4 Analyse

The root causes of the gaps have been identified and evaluated according to the cause and effect diagram. The causes have been grouped within management, individuals, organization, and process areas and can be illustrated in the cause and effect diagram, Figure 13.
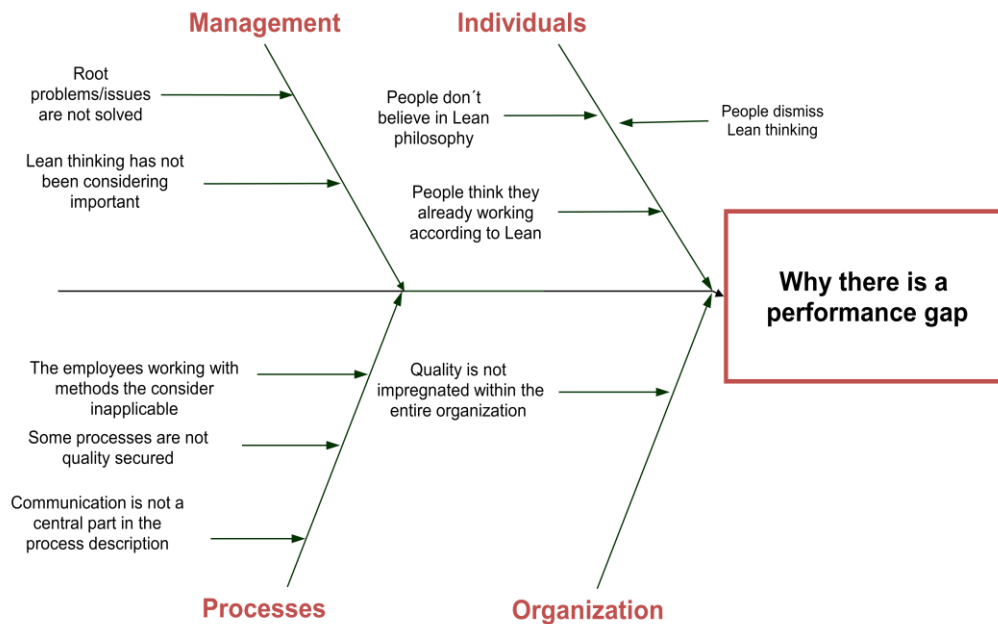
.



**Figure 13.** Cause and effect diagram of the "performance gap" in the benchmarking.

*Management:* Management does not solve the root causes of the problems/issues that the employees are pointing out and/or that are identified. There is a very far-reaching feedback of the idea or problems that are discussed and about to be solved. Lean thinking does not impregnate the department of FVV and the employees are not aware of its philosophy and context. One of the causes of this phenomenon can be that management has not considered the Lean way of working as important.

*Individuals:* Employees at the department of FVV do not fully understand the theory of Lean. People dismiss the Lean term and believe it is unnecessary due to the poor understanding of its actual contents and meaning. Some employees believe that they are already working according to Lean which inhibits their continuous development of improving the qualitative work. The employees consider the meetings once a month at FLGOT (Feature Leader network Gothenburg) as a very important forum for discussions and idea generations. However, everyone does not get the opportunity to express his or her thoughts due to the limited time of the meetings. Discussions are often at high levels and sometimes difficult to follow. Some people talk more than others and prevent them from expressing their considerations.
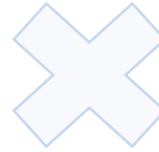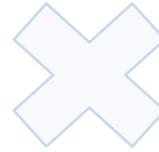
*Organization:* The Lean thinking is not impregnated from the bottom to the top of the organization and the organization does not seem to strive to implement it thoroughly. However, some Lean tools are used from time to time, but somehow it seems that the organization has not been successful in implementing Lean thinking. This could be due to that people within the organization do not believe enough in the Lean philosophy and/or do not have sufficient knowledge about it, and perhaps also resistance to change.

*Processes:* The process way of working is not focusing on how to work in a project, but more on what to perform in the work. The processes descriptions do not include communication strategies which is an important aspect in the project work. This is limiting the employees' work of how to perform optimally. The employees are working with methods and documents that they do not understand and/or consider as unimportant for the work, which inhibits the development of the Lean introduction into the company. It is established that within projects, Project Leaders are performing their own process within the global process. A consequence of this is that participants within projects can never be sure of how the "internal" project process is formed, and how to work from project to project, since GDI:s of different processes are not followed.

### 7.1.5 Adapt

The main gaps identified have been evaluated in order to determine what factors to recommend for improving the Feature Leaders way of working. The areas of interests have been specified in the gap analysis table below. In the table below the current situation at the feature area at Volvo GTT has been described in the left column, statements of the desired situation have been determined in the upper row, and performing actions are described in the matrix formed by the current situation and the desired situation.

**Table 7.** Result evaluation of the Benchmarking

| From ⇓ | To ⇒ | *Description of desired situation* | **Problem solving** Involve the employees to be part of problem solving related issues. | **Idea generation** Use the employees' thoughts in the improvement work. | **New employees introduction to their work tasks** Make sure that every new employee gets a qualitative introduction to his/her work and an acting mentor. |
|---|---|---|---|---|---|
| *Description of current situation* | | | | | |
| **Problem solving** The employees are not part of solving identified problems. | | ✗ | Use the improvement board and make sure that everyone participates. | ✗ | ✗ |
| **Idea generation** The employees cannot thoroughly express their considerations/ideas. | | ✗ | ✗ | Ensure that everyone's thoughts and ideas are identified by having idea generation forums and/or an idea box. | ✗ |
| **New employees introduction to their work task** Many employees who started as FLs were not properly introduced to the work tasks or the organization. | | ✗ | ✗ | ✗ | Establish an introduction portfolio that systematically describes the department and the FL generic work tasks and make sure that there is a proper introduction to the training material. |

| From ⇓ To ⇒ | User-friendly databases<br><br>The intranet is an easy-use base. It is easy to find specific information and perform searches there. | Communication<br><br>Communication must be a natural way in the daily work. More communication face to face in the effort to eliminate misunderstandings. | Decentralized organization/department<br><br>Give the employees more responsibilities in the action/recommendation of how to change the organization/department/groups to the better. Let the term self-management become a natural factor. |
|---|---|---|---|
| **User-friendly databases**<br><br>Today, employees are not aware of how to find specific information in the intranet and the PDM system. | Make Team-Place simple, a logical structure. Establish a complement to Team Place as "Wikipedia" forums. | ✗ | ✗ |
| **Communication**<br><br>There is a lack of communication between functions in a project, people are not aware of each other's performances. | ✗ | Have more meetings with the functions in a project to state what each individual is about to perform as a next step in his/her work. | ✗ |
| **Decentralized organization/department**<br><br>Employees have lots of ideas on how to improve which are not always considered. | ✗ | ✗ | Establish forums or weekly meetings where the employees can meet and discuss and hands-on affect issues that they have identified. |

| From ⇓ | To ⇒ | Knowledge/view of the entire project process<br><br>The employees are aware of what is happening in other functions at different times and can visualize the project process. | Customer satisfaction within the organization<br><br>Every employee within the organization should be aware of how well the work they have performed is perceived by the receiver and vice versa in order to achieve high quality of the work distributed through the projects. | Control of the information flow<br><br>The employees working in a project should be aware of where to their work is distributed and what happens next with the documents that they have worked with. |
|---|---|---|---|---|
| **Knowledge/view of the entire project process**<br><br>Employees do not have the overall view of how a project is formed and in what stages specific tasks are performed by different functions. | | Introduction and education about the processes, both the FDP and the GDP. Ensure as a manager that the employees understand the process and are working accordingly. | ✕ | ✕ |
| **Customer satisfaction within the organization**<br><br>There is no awareness of how satisfied the receiver is with the information/documentation that the FL distributes to other functions. | | ✕ | Make continuous internal customer-supplier satisfaction audits. Improve and change where there is low quality satisfaction in the effort to improve the work quality. | ✕ |
| **Control of the information flow**<br><br>The information distributed throughout a project is not well defined and employees are not aware of the information flow or where the information is finally located. | | ✕ | ✕ | Continuously perform audits of the documents/information that is distributed in a project. Make sure that the employees are fully introduced to the project information flow. |

### 7.1.6 Improve

The benchmarking study has established a foundation knowledge set of Lean thinking, both on the individual level and in an organizational manner. The different organizations that have been benchmarked have in different ways visualized both in theory and practice how Lean can be implemented in an organization in a successful way. The benchmarking showed that in order to succeed with quality improvements in an organization everyone within it must be on board. If Lean is correctly implemented it is possible to involve everyone. Lean can be used as a start-up model and guideline for quality improvements from the bottom to the top of an organization. It is important to remember that Lean is a philosophy, not just a collection of tools. Lean has to be impregnated into the entire organization. In fact, the Lean tools do not necessarily need to be used, a company can be Lean anyway. It is important to remember to use the right tools for the right purpose and to choose carefully and re-design or perhaps invent own tools so that they suit the company. The organizations in this study have showed that it is manageable to implement Lean in an organization. How successful the implementation will be is a question of respect for and conviction of the soundness of the theory behind Lean, and that the company uses that as a base when introducing the concept to its personnel.

# 8 Performance

The execution phase of the project was performed based on the literature study and the theory findings. Identification of contradictions and problem related issues was made using value stream mapping (VSM) of the Feature Development Process with an in general larger project as reference. The VSM was performed in Cross Functional workshops and reviews which will be explained later. Further, individual interviews, individual workshops, experiments, group interviews, cause and effect analysis, and documentation flow analysis were performed and used for data collection. These actual performances in this Master Thesis project are described in this chapter.

The collected data from all sessions performed in this project has been evaluated anonymously and all gathered information from participants will be destroyed. Note that the title "Feature Leader" in the report does not indicate that the particular statements are the views of all Feature Leaders in the entire organization.

## 8.1 Individual Interviews

The individual interviews were performed at the department of Feature Verification & Validation (FVV) in Gothenburg and Lyon at Volvo GTT. The main interviews were performed in Gothenburg since that is where the project was carried out. The interviews with the Feature Leaders were mainly focused on an overall view of their work in general. This was a major part of the project work in order to provide an understanding of the actual work tasks of a FL, and what is working well today and what is not. The interviews were aimed at getting a picture of in what way the Feature Leaders are interacting with other functions and processes. It was established who their major and critical partners are in their daily work within a product development project. In the interviews the Feature Leaders could give a clear and distinct description of the features that they were working with, which was necessary to understand in order to improve the product development process.

The history of the FVV department way of working was another significant part in the quality improvement work which was utilized in those interviews. In that way the department's and organization's culture and mentality was understood and considered.

The questions that have been asked to the Feature Leaders are stated below and the information conducted at the interviews has been gathered, structured and evaluated.

*The main questions asked at the interview session with the Feature Leaders:*

- What feature are you responsible for?
- For how long have you been working as a Feature Leader?
- What projects are you working in at the moment?
- Who are your stakeholders?
- Who do you interact with throughout a project?
- Do you regard any areas as problematic in your work tasks today?
- Can you describe the modes that you are performing during a project?
- How familiar are you with the GDP, the GDI of the FDP as well as other GDI:s?
- Are you familiar with the existing training material?

- Do you think that the training material for Feature Leaders help you in your daily work?
- Do you consider that there are any problem areas of in your daily work?
- Do you think that there are any contradictions or conflicts in your interaction with related functions when working in projects?

In addition to the interviews with the Feature Leaders, several interviews were performed with personnel from related functions, which is displayed in Table 8 below. The quality improvement work in this Master Thesis project indicated the importance of evaluating other functions considerations when interacting with Feature Leaders in projects. They have therefore been regarded as significant inputs in the result part of this report.

Apart from the interviews described in the text above, interviews have been performed in order to evaluate the existing training material for Feature Leaders. Together with the former training material establisher Ms Hanna Ljungqvist[2], the training material was discussed regarding its creation in 2009. The training material was thereafter evaluated with three Feature Leaders one by one. The Feature Leaders age, number of years in the business, and experiences was taken into account in order to get spread considerations. The aim of the sessions was to get the Feature Leaders inputs of how relevant, pedagogical and understandable the existing training material is and what can and should be updated and improved.

## 8.2 Individual Workshops

The individual workshops have been differently performed based on different purposes. Two workshops were performed with two different Feature Leaders. The aim was to map the general activities in a project on a sheet and exclude other functions activities. The result was used as a base for the Cross Functional Workshop that was later performed. The activity sheet was used as a foundation to help the other Feature Leaders that participated in the Cross Functional Workshop to remember the activities that they carry out in a project. This was performed due to the fact that the large projects often run over by several years at Volvo GTT and that employees are entering projects at different stages. By getting several Feature Leaders inputs it could be secured that all activities performed in projects were identified.

## 8.3 Value Stream Mapping - Cross Functional Workshop

In order to provide a picture of the current situation by making a Value Stream Mapping of the Feature Development Process, five different Cross Functional Workshops were performed. Five features were selected to be investigated based on the importance to get the proliferation. Their functionalities, level of interaction at different stages/phases in projects and their complexities were considered.

Projects at Volvo GTT often run for several years. This makes them quite complex and involves a huge amount of interactions and procedures among people and processes. This

---

[2] Interview with Ms Hanna Ljungqvist, Business Consultant within Volvo Group Trucks Technology (2012)

situation required a customized Value Stream Process Mapping. Consequently, the mapping process did only fulfil a number of points that are recommended in the literature. However, this has a minor impact on the result since it is the organizations way of working that is important to conduct the process flow.

**Table 8.** Individual interviews performed.

| Site Function | GOT | LYON | AGEO | GREENSBORO | TOT: |
|---|---|---|---|---|---|
| Feature Leader | 19 | 4 | 0 | 0 | 23 |
| Project Manager | 2 | 0 | 0 | 0 | 2 |
| Design Engineer | 2 | 1 | 0 | 0 | 3 |
| Calculation Engineer | 2 | 1 | 0 | 0 | 3 |
| Requirement Manager (Systems Engineering) | 2 | 2 | 0 | 0 | 4 |
| Product Planner | 2 | 1 | 0 | 0 | 3 |
| Test Engineer | 1 | 0 | 0 | 0 | 1 |
| Training Material Developer | 1 | 0 | 0 | 0 | 1 |
| RnD30 | 1 | 0 | 0 | 0 | 1 |
| **Total:** | **32** | **9** | **0** | **0** | **41** |

The features Durability, Handling, Maintainability, Fuel Economy, and Driver Interface were the ones selected for the Cross Functional Workshop. Functions connected to those features

were selected to be part of the session. The Cross Functional Workshop of Durability and Handling was performed in Gothenburg whilst the Driver Interface, Maintainability and Fuel Economy workshops were performed in Lyon, France.

These five features each correspond to one Cross Functional Workshop. The sessions involved the Feature Leader and six functions interacting in a specific project. The in total seven functions mapped the activities of the current situation in today's major projects at Volvo GTT.

The workshop was performed by first letting the Feature Leader map the activities that he or she performs during a larger project. The Feature Leaders also mapped the other related functions activities that he/she was aware of, during a project, in order to see the interactions. To state the activities, the Feature Leader used yellow sticky notes which each correspond to one activity. The notes were ordered in a time frame perspective on a specific sheet, see Figure 14. The sheet contained all the seven functions that were part of the workshop. There was one sheet for each of the different gates that are passed in a project and in that way the time frame in a project was specified.

After the Feature Leader had set the activities during a session, the other functions, see Figure 15, one by one mapped their activities during a project which were linked to the Feature Leaders work. Each function had specific colours on their sticky notes, in order to control and identify who had mentioned which activities on the sheet. In the same way as the Feature Leader they also mapped activities that they were aware of that the other functions perform.

When questions arose during the workshop session, question marks were put up. In that way the participants from the different functions were able to discuss the questions and contradictions after the workshop sessions in a specific review that is explained later in this report.

The layout of the sheets that was used for each gate in this workshop can be seen in Figure 14. The five workshops resulted in five project descriptions of activities for the different features. A visualized example prior to FDCG can be seen in Figure 15, where all the different sticky notes from the different functions are displayed.

**Figure 14.** Cross Functional Worksheet.
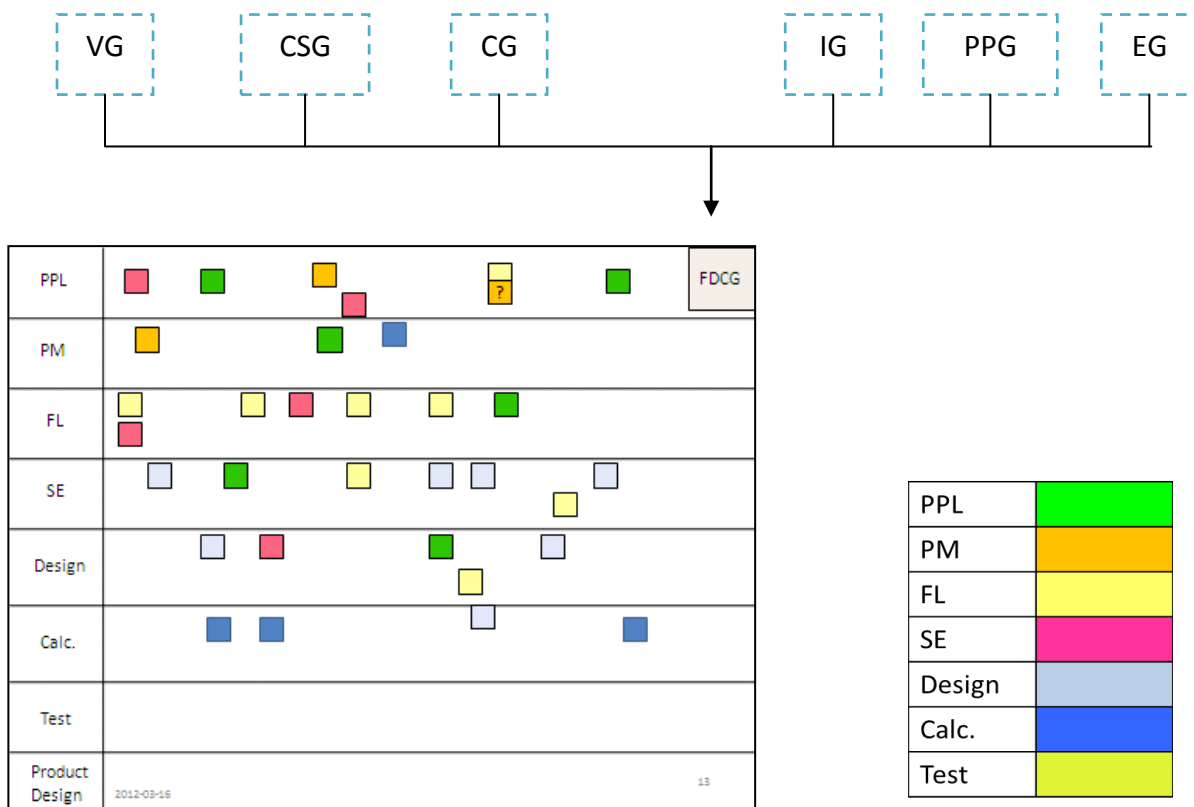


**Figure 15.** Cross Functional Workshop process.



**Figure 16.** Functions involved in the Cross Functional Workshop.

**Figure 17.** Pictures from the different Cross Functional sessions in Gothenburg and Lyon.

## 8.4 Review

The two Cross Functional Workshops performed in Gothenburg were followed by reviews with the participants from the functions attending the workshops. The participants in the Cross Functional Workshop performed in Lyon were provided with the entire process mapping via email. The review was not performed physically, but instead they forwarded their considerations on the outcome via email.

In Gothenburg, the review session was a sequel procedure performed after each of the Cross Functional Workshops. The aim with the reviews was to gather the people that participated in the Cross Functional Workshop to meet physically and view the mapping that they had performed together but in individual sessions. The questions that arose during the workshop could be analysed, discussed and determined. The participants decided together in a final draft where, by whom and when the activities are performed in time in a major project. The VSM of the five workshops is illustrated in Figure 18.

The review provided a more qualitatively secured process mapping, due to the possibility for the participants in the end to discuss, and come together as a team to agree on the activities that they perform in a project.
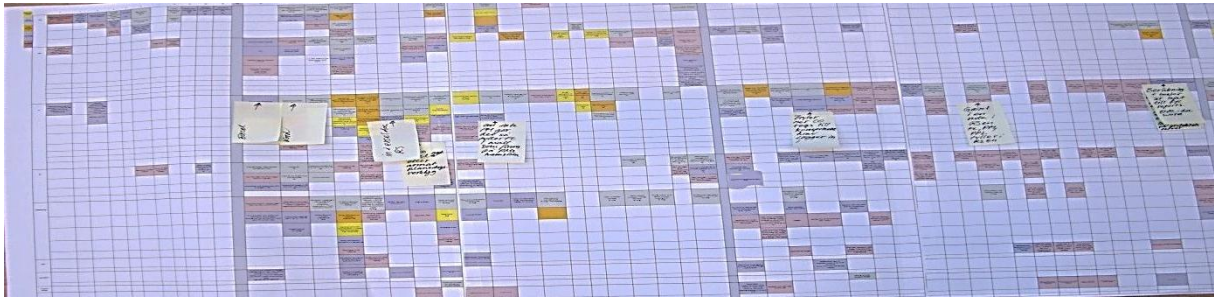
**Figure 18.** This picture illustrates how the VSM collection of the five features Cross Functional sessions were gathered in one Excel sheet.

## 8.5 Group interview

A main factor in quality work is to ensure that the employees' thoughts and considerations are regarded and hopefully solved in one way or in another. The group interview was represented by four Feature Leaders and one Feature Coordinator at the FVV department. The Group interview aimed at letting the participants discuss with each other about different areas related to quality work:

- Basically, why do problems occur in the first place in organizations?
- How do you generally solve problems?
- Why are problems in organizations not solved?
- Why are problems at Volvo GTT not solved?
- How should one work in order to prevent problems from occurring in organizations and at the department of FVV?
- How should one work in a systematic way in order to prevent problems from occurring?

The purpose was to let the participants brainstorm about their thoughts regarding the different areas specified. The points that were discussed in the group were stated on the whiteboard for the different areas. The objective in the questions was to get the participants to think on their own about which activities in their daily work those are not value-adding for themselves or for the end product. The objective was also to let the participants themselves come up with how they would like to work in order to prevent non-value adding activities from occurring and find solutions to reduce, and preferably eliminate altogether, existing non-value adding activities.

## 8.6 Cause and effect analysis

The main problems identified in the interviews, individual workshops, cross functional workshops, and the survey have been analysed and evaluated in cause and effect diagrams in order to determine the root causes of the identified issues. Two Feature Leaders were involved in two sessions where they individually produced diagrams of their considerations regarding two identified minor quality related issues in the Feature Leaders work at Volvo GTT. The different root causes areas that were investigated were Management, Individual, Process, Organization, Culture, and Politics.

Additional performed cause and effect analysis of main problems identified have been evaluated in Chapter 9 in this report.
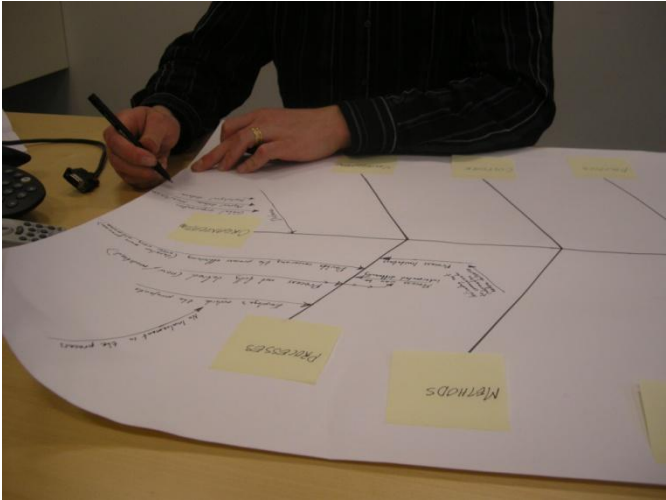


**Figure 19.** Cause and effect session.

## 8.7 Survey

The primary data collection was conducted by qualitative in-depth interviews and workshops performed in the project. As support for the collected data in the interviews and workshops, qualitative and quantitative data was gathered by a survey that was sent out to all Feature Leaders in Gothenburg, Lyon, Ageo, and Greensboro. The survey design was performed in Excel and constituted the main driving questions that were identified as problem areas in the work of the Feature Leaders. The main driving questions were also established in order to identify the Feature Leaders view of different areas that could affect the Feature Leaders work in a project process. The survey treated five different areas. They were: Communication, the Requirement Specification, the Contracts, the FL Training material and one area of additional questions. The different questions can be viewed in Appendix C.

The results from the survey were used in this Master Thesis as measurable statistical data. They were used as a foundation for the analysis of recommendations of how mode of operations in the Feature Leaders work can be more qualitative secured. Table 9 shows the response frequency of the survey.

**Table 9.** The survey frequency response.

|                  | GOT | Lyon | Ageo | Greensboro |
|------------------|-----|------|------|------------|
| Respondents:     | 17  | 9    | 9    | 1          |
| Sent to:         | 31  | 23   | 18   | 14         |
| Respondents in % | 55  | 39   | 50   | 7          |

## 8.8 Experiments

Non-value adding activities are important to identify in quality work in order to be able to reduce and if possible eliminate them.  The purpose of the experiment that was performed in this project was to specify how much Feature Leaders were exposed to activities that were not related to their work. It was a way to quantify the frequency of non-value adding activities during a specified time. The experiment sheet can be viewed in Appendix D.

## 8.9 Information flow

In general, when projects are running, information are distributed around the organization and functions. The transportation of information in projects where Feature Leaders are involved has been displayed in the process map in this project. Two sessions have been carried out where two different Feature Leaders have clarified which documents are used in the different activities in the larger projects. The data collected to present the result in the documentation flow analysis is also based on information gathered from interviews and workshops.

## 8.10 Activities performed

20 features out of the 34 features in total have in different ways been involved in different stages of the project. They are specified in the Appendix E.

Table 10 lists the number of performed activities at the different sites. A total number of 61 activities have been completed during this project. 41 individual interviews have been performed with different functions Volvo GTT.

**Table 10.** The sessions performed in this project.

| Sites / Activities | GOT | LYON | AGEO | GREENSBORO | TOT: |
|---|---|---|---|---|---|
| Individual Interviews | 32 | 9 | 0 | 0 | 41 |
| Individual Workshops | 7 | 0 | 0 | 0 | 7 |
| Cross Functional Workshops | 2 | 3 | 0 | 0 | 5 |
| Cause and Effect analysis | 2 | 0 | 0 | 0 | 2 |
| Information Flow analysis | 2 | 0 | 0 | 0 | 2 |
| Experiments | 2 | 0 | 0 | 0 | 2 |
| Group Interview | 1 | | | | 1 |
| Total | 45 | 12 | 0 | 0 | 60 |
| Survey | | | | | 1 |
| Total no. of activities performed | | | | | 61 |

# 9 Results

This chapter displays the result from the analysis on the information conducted on the interviews, workshops, and the survey.

## 9.1 Interview and survey findings

The results from the interview and the group interview sessions contributed to the identification of several problem and conflict areas. As a result, a total number of 65 identified areas of different levels were considered as non-value adding activities. The areas identified are described in this chapter and are related to the Feature Leaders work tasks in projects and their interaction with other functions in the organization. The level of impact regarding the problem areas stated is in relation to the Feature Leaders work, the organization. All areas are visualized in Appendix F. The data collection is the foundation of the result, analysis, and recommendation and is based on the 41 interviews and the 59 operations that have been performed.

The survey findings resulted in both quantitative and qualitative data, based on the answers from the Feature Leaders. The respondent frequency of the survey from the different sites can be viewed in Figure 20.  Ageo had a response frequency of 50 %, Lyon 39 %, Greensboro 7 % and Gothenburg 55 %. Due to the poor response from Greensboro, it was decided to exclude that site. The result of the entire survey can be viewed in Appendix C.
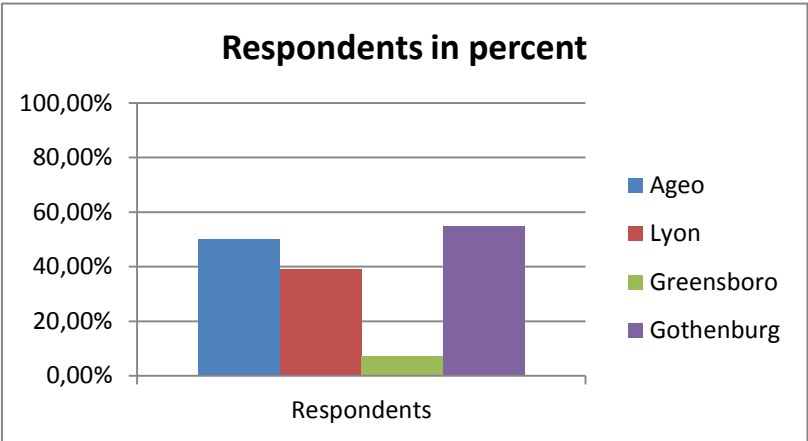
**Figure 20.** Respondents of the survey.

Based on the three principle areas (chapter 6) in Lean Product Development, an evaluation of the integration and establishment level of the Lean Product Development principles at Volvo GTT has been performed. The data foundation is mainly based on the Feature Leaders mode of operations throughout a larger project. The interaction with other functions and processes has been evaluated.
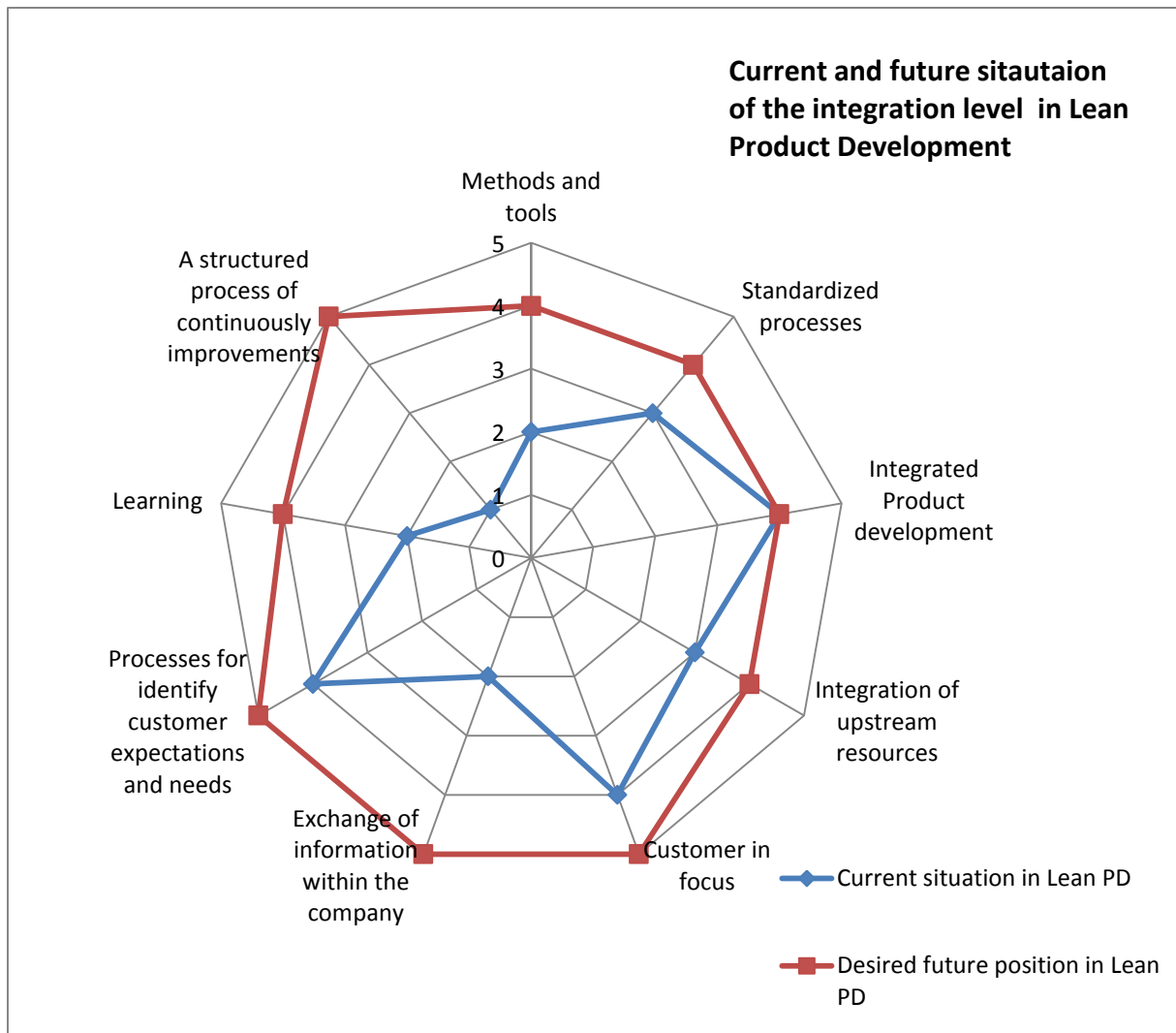
**Figure 21.** Current and Desired future position of the Lean principles integration at Volvo GTT.

Figure 21 illustrates the evaluated current situation of Lean Product Development integration (the blue line) and the desired future situation (the red line) at Volvo GTT with focus on the Feature Leaders work tasks and their interaction with other functions.

The evaluation of the current situation at Volvo GTT with respect to the different points in Figure 21 is described in detail as:

- ❖ *A structured process of continuous improvements:* It has been indicated that there are no standardized methods or models of how to process conflicts or contradictions when they occur.
- ❖ *Methods and tools:* Volvo GTT is at the moment working with a lead time reduction programme, with the aim to provide more efficient processes. However, the need for more hands on Lean methods and tools are not met or used among the Feature Leaders or other functions in today´s projects.
- ❖ *Level of how well the standardized processes are followed:* Working procedures are well established and standardized within Volvo GTT. However, they are not in accordance with the process, which contributes with defects in projects.

- ❖ *Integrated product development:* The product development process that is performed by Feature Leaders is well anchored. However, the mapped Feature Leader activity process, which is provided in this report, indicates that there are some areas that must be adjusted and processes that need to be checked since they are not completely followed.
- ❖ *Customer in focus:* Volvo GTT provides optimal products to the market and fulfils the market demands. However, the internal customer must be considered. How well the internal customer is satisfied is a factor that must be evaluated within the organization.
- ❖ *Exchange of information within the company:* Communication is lacking in some areas and must be improved to become more qualitative when exchanging information.
- ❖ *Processes for identifying customers' expectations and needs:* Volvo GTT has well-structured processes for capturing the customer needs.
- ❖ *Learning:* There is a need for a better process of how to learn from mistakes and successes in order to improve the mode of operations.

Based on this evaluation of the level of Lean Product Development at Volvo GTT, the main areas that need to be considered and improved in order to provide a more Lean focused environment are:

- ❖ A structured process of continuous improvements
- ❖ Methods and tools
- ❖ Information exchange
- ❖ Learning
- ❖ Following the standardized processes

## 9.2 Experiments

The experiments were performed in order provide quantitative data on how much time the Feature Leaders actually are interrupted in their work during a work day by letting them fill in a template (see Appendix D). The interruptions were mostly concerning the Feature Leaders actual work tasks. The experiment showed that the interruptions lasted between five and thirty minutes. The time it took to go back to the task that was executed just before the interruption occurred was five minutes and upward. Furthermore, the Feature Leaders get a large amount of emails that do not concern their work.

## 9.3 Identified Conflicts & Contradictions with the related processes

The identified conflicts and contradictions from the different processes Systems Engineering (SE), Product Planning (PPL), and Complete Vehicle Verification & Validation Plan ($CV^3P$) are stated below. The issues are explained in this chapter.

### 9.3.1 Identified conflicts/contradictions with the <u>Systems Engineering (SE)-process:</u>
- The Requirement Specification does not contain "carry-over" requirements.
- The Feature Leaders perceive that it is difficult to state requirement in relation to the Systems Engineering SMART approach.

- It is not always obvious that System Engineering uses all the Feature Leaders inputs regarding what requirements that should appointed to be the overall (main) requirements in the Requirement Specification. Consequently, critical requirements have sometimes been excluded from the Requirement Specification, which have affected the project negatively.

- The Feature Leader is within the System Engineering process named CORO (Complete Offer Requirement Owner), instead of Feature Leader. This tends to be confusing.

- The balancing procedure is unclear since it has no distinct process flow.

- Feature Leaders are using different documents for the same purpose when distributing requirements at different levels to SE.

- The feature status in the Requirement Specification is green while it in fact is red, due to that lower level requirements are red but are not regarded in the Requirement Specification.

### 9.3.2 Identified conflicts/contradictions with the <u>Product Planning (PPL)-process:</u>
- Feature Leaders are not informed about important events/decisions concerning their work and/or feature because PPL do not report to functions at lower levels.

- Feature Leaders are required to report additional status at pre-feature reviews and pre-pre feature reviews, in order for PPL to be sure that the Feature status is OK prior to the official Feature Reviews.

- At Feature Reviews the stakeholders are more interested in the status colours than of the actual status of the feature achievement.

### 9.3.3 Identified conflicts/contradictions with the <u>CV$^3$P-process:</u>
- The V&V plan and Cost plan have to be developed by the Feature Leaders early in projects when the Feature Leaders might not have the entire view of how time, cost, and man hours should be delegated in the best of ways, or of the number of tests required.

## 9.4 Waste in Product Development

The data collected from the interviews and VSM that was performed concurrently with Feature Leaders, Project Managers, Design Engineers, Product Planner, Calculate Engineers and Requirement Managers has been critical parts in this project. The data from these sessions formed the foundation of the major and crucial areas that were considered as problem related in the project work at Volvo GTT. The problem related activities have been grouped into different waste categories, see Figure 22.

According to the Feature Leaders interaction in projects the largest waste in the product development was *unnecessary motions* with a frequency of 20 %. Close after comes *defects* with a frequency of 18 % and *rework* with a frequency of 16 %. According to the literature all identified waste in product development must be reduced. However, the crucial part is to be

aware of its existence and initiate an improvement programme of how to eliminate it incrementally.
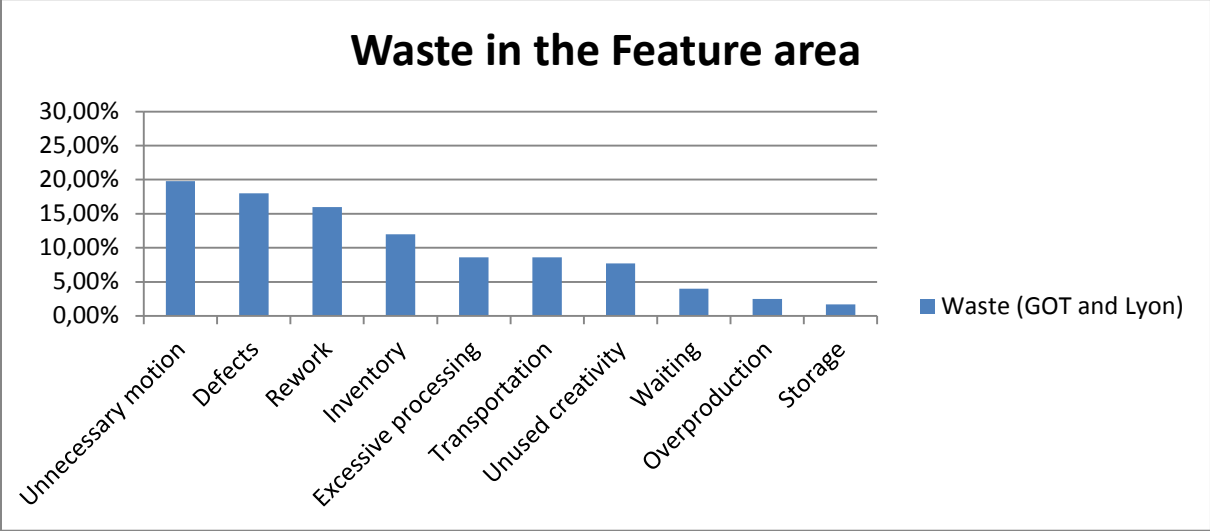


**Figure 22.** Waste frequency in the feature work at Volvo GTT.

Some of the results of the waste identified are described below. The constituent parts within the different waste categories can be viewed in Appendix G (all the identified problem areas can be viewed in Appendix F).

*Unnecessary motions*

- Uninformed:
  Feature Leaders are not informed of important events/decisions concerning their work and/or feature.

- Status reporting:
  Feature Leaders believe that unplanned status reporting and pre-pre feature reviews impede their effort to provide quality work. Unscheduled meetings contribute to inefficiency and the difficulty of working according to schedule.

- Cultural differences:
  The fact that people from different countries and backgrounds interact intensively during a project causes many misunderstandings and need for rework and/or extra clarification sessions.

- Interaction with Engineering:
  The interaction between Feature Leaders and Design Engineering need to be clarified. The different functions have different views of what their actual work tasks are. There is no common view of the different functions responsibilities. It has been found that Design Engineering sets their own requirements and disregards the Feature Leaders requirements.

- Feature Leaders work is not respected and thoroughly anchored within the organization:
  Feature Leaders consider that their role is not optimally anchored in the company which contributes to losses of information, clarifications, and a feeling that there is a need to claim their role and inputs.
  It has also been found that some project manager do not have a clear and correct view of the Feature Leaders work tasks and their role in projects.

- Processes:
  Projects do not follow the GDP or the GDI:s that are established for the entire organization. In some projects it has been indicated that the "project" sets their own internal process. A consequence is that functions have to follow new internal processes that are not standardized.

*Defects*
- Feature status:
  It has been found in some projects that the feature status in the Requirement Specification is green while it in fact is red. This is due to the fact that the Requirement Specification can only handle a limited number of requirements. Only the overall requirements are specified, which implies the lowest technical requirements are sometimes not considered and can in fact be red while the overall project shows green in the Requirement Specification.

- Risk List:
  All requirements can sometimes not be fulfilled, and those unfulfilled are then balanced into a level that the project can deliver. However, if there is a requirement that cannot be agreed upon between different stakeholders, and the project does not accept balancing, the requirement can be put on a "risk list". This is considered by the respondents from the interviews to be a way to walk around the problem instead of properly dealing with it.

- Requirement Specification:
  Employees consider it difficult to get an overall picture of the requirements in the document.
  In the Requirement Specification the status for SP start is visualized, based on the current situation in the project for each feature. Since it is found that less important technical requirements are sometimes not regarded when the current situation is stated, the status for SP start might provide incorrect information. This might make people think that they will manage to reach green status at SP start, while in reality they will not.

*Rework*
- Poor communication:
  It has been discovered that the communication is not optimal between functions in a project. The lack of good communication leads to misunderstandings and rework.

- Introduction to new methods:
  When new methods and processes are to be implemented in the organization, there is a lack in the information distribution to the concerned employees. It is not only a matter of the information distribution, it is also the responsibility as a manager to ensure that the methods and processes have been thoroughly understood by the employees and secure the understanding by continuously feedback.

- Introduction to new Feature Leaders:
  It has been discovered in many places that Feature Leaders have been working several years in their role without understanding their current working methods in a project and/or responsibilities. The introduction part acts as a foundation base of information for the future. There is no clear description or any process at all that describes how to take care of new employees.

*Inventory*
- Unnecessary Emails:
  It is very common among employees to send emails to people "just in case" even if it is not sure that the receivers are affected or in need of the information.

- Team Place:
  According to the Feature Leaders it is difficult to find specific information in the intranet database.

- FL Training Material:
  The FL Training Material document is according to the Feature Leaders difficult to find in the Team Place. All Feature Leaders are not even aware of its existence. There is also a need for more distinct descriptions of the information included in the FL Training Material.

- Knowledge:
  Competences regarding specific areas are missing. Technical skills are poor in some areas and the loss of competence has increased. This is partly because the use of consultants has increased in the last 10-20 years and partly due to a different employment policy approach.

*Excessive processing*
- Feature Review:
  An indication has been found that stakeholders and involved parties are only interested in the status colour (red, yellow, green) of the SP-start box, and that other information is not interesting or discussed during the status reporting at the Feature Reviews.

- FMEA:
  Some employees do not know where the FMEA report is distributed, and if they are followed up.

- White book:
  The purpose with the white book as a Lesson Learned session is very good from a qualitative point of view. However, the employees are never informed about how the information is used afterwards. There is no feedback regarding the book's contents or a distinct process that describes its function in projects.

*Transportation*
- Uninformed:
  The fact that Feature Leaders are sometimes uninformed about factors that affect their work contributes to additional hunting of information around the organization.

- Difficulties setting the Requirements:
  Sometimes the Feature Leaders sometimes have problems specifying the requirements based on the targets and/or the SMART approach. System Engineering needs to go back to the Feature Leader in order to clarify that the requirements are established according to the SMART methodology. This implies additional interactions that might not be needed in an optimal process with clear instructions and knowledge.

- No project view:
  Different functions in a project do not have the correct view of what other functions are actually performing. Participants have different views of the project status.

*Unused creativity*
- Responsibilities:
  Principles for delegation of responsibilities and who are the owners of different processes and documents are unclear. This must be clarified and structured.

*Waiting*
- Look for people:
  A lot of time is spent on searching and phoning people to get the correct information.

- Poor communication:
  Poor communication often contributes to misunderstandings and waiting for clarification.

*Overproduction*
- Administration:
  A lot of administration and bureaucracy is established in the organization. Permission is often required (which is time consuming) to, for example, enter special forums.

- Processes/methodologies:
  A lot of information has to be documented during projects. Employees think that this prevents them from performing their actual and prioritized work tasks in projects.

- Acceptance of targets:
  The Feature Leaders get requirement documentation even if they are not affected by the project. A Feature Leader must study the requirements documentation to find out if the project will affect his/her feature or not.

- Launched tools:
  The production tools are today launched too early, before it is ensured that the requirements will be fulfilled.

*Storage*
- Status reporting:
  The Feature Leader is sporadically requested to report status of the feature in excess of at the Feature Reviews, which is not according to the process.

- High workload:
  The Feature Leaders sometimes have a high workload and they must therefore delegate work to others. This is not satisfactory since it is difficult to delegate this type of work while at the same time uphold the quality of it

## 9.5 Major problems identified

The different problem areas identified from the interviews in Gothenburg and Lyon acted as foundation areas in the survey. Since the survey gave measurable values of which the non-value adding areas were, the survey findings were used as a basis to determine which main areas that have to be improved. The survey result can be viewed in Appendix C. The *carry overs*, *balancing procedure* and *the use of contract* have been found as the main providers of non-quality adding activities of today's work, see Figure 23. They are specified more in detail below.  It was however decided to also include the problem areas *uninformed*, *traffic light,* and the additional area in the evaluation *communication* in the evaluation.

- 77% of the respondents considered the process of how *carry overs* are handled in the Requirement Specification as a problem. The frequency respondents GOT: 100 %, Lyon: 89 % and Ageo: 23 %.
- 54,3 % of the respondents believed that the balancing procedure is unclear. Response: GOT: 83 %, Lyon: 45 % and Ageo: 67 %.
- 53,8% of the respondents believed the use of the contract as a main problem. The response frequency GOT:76,5 %, Lyon: 89 % and Ageo: 67%.
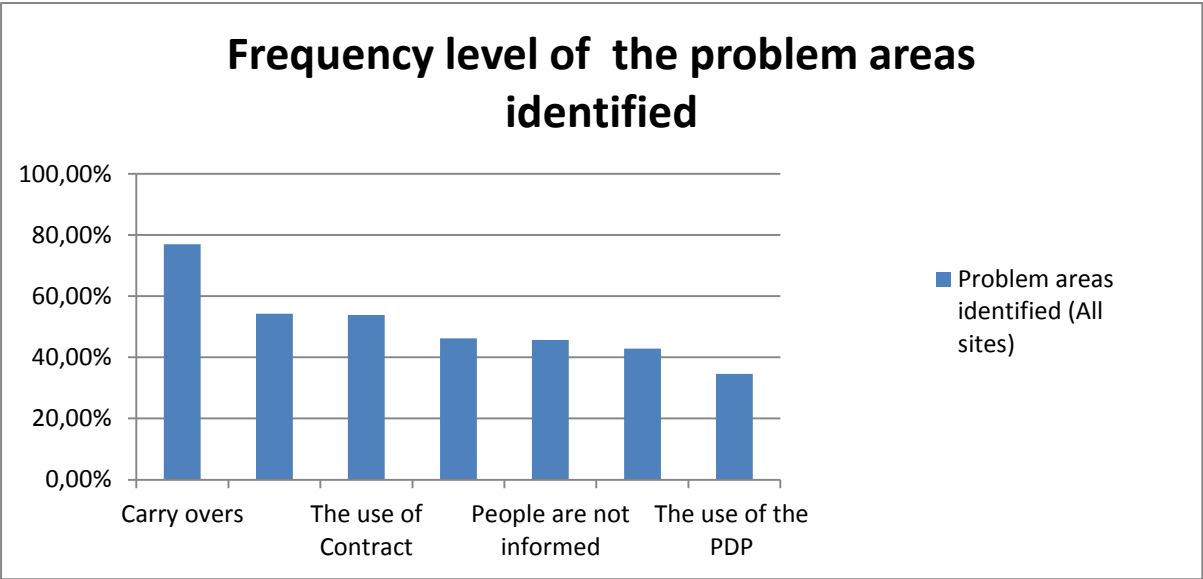
**Figure 23.** Frequency level of the problem areas identified.

The three areas: carry overs, balancing procedure and the use of contract have been evaluated in cause and effect diagrams in order to determine the root causes of their existence. Organization, Management, Culture, Individuals and Processes were the five areas that were analysed.

**Carry overs**

Almost 80 % in Gothenburg and in Lyon regarded the deletion of the carry overs in the Requirement Specification as a problem, see Figure 24. The majority of those who made this statement believed that the exclusion of the carry overs in the RS negatively affects the project outcome. The Requirement Specification is a part of the Systems Engineering process.
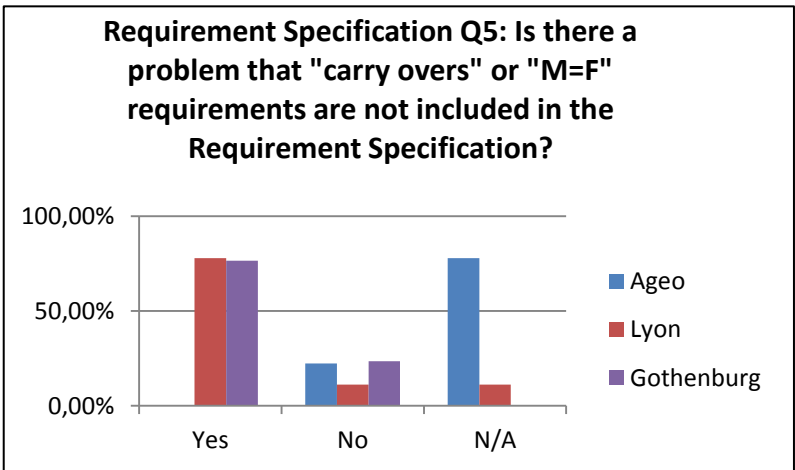


**Figure 24.** Diagram from the survey of the "carry overs" issue.

The qualitative data collected by the survey specified that the way of working with the "carry overs" was lacking in different areas such as:

- The "carry overs" are not always considered during the project execution which causes damages to the end product and the performance of the project process.
- Newly employed engineers do not have the knowledge and experience of the carry overs from previous projects, which consequently contributes with loss of important requirements.
- Design Engineering does not have the knowledge of the "carry overs" and can in some cases redesign solutions without realizing that the change may influence other requirements and solutions.
- Requirements are changed over time in projects and can unnoticed affect "carry overs" requirements.
- The "carry overs" are not specified in a standardized document.
- Some Feature Leaders do not store all the carry overs in a specific database, and many requirements that have already been stated therefore need to be restated.

Based on the result that indicates that the "carry overs" are handled inappropriately, the root causes of the results have been evaluated and are shown in Figure 25.
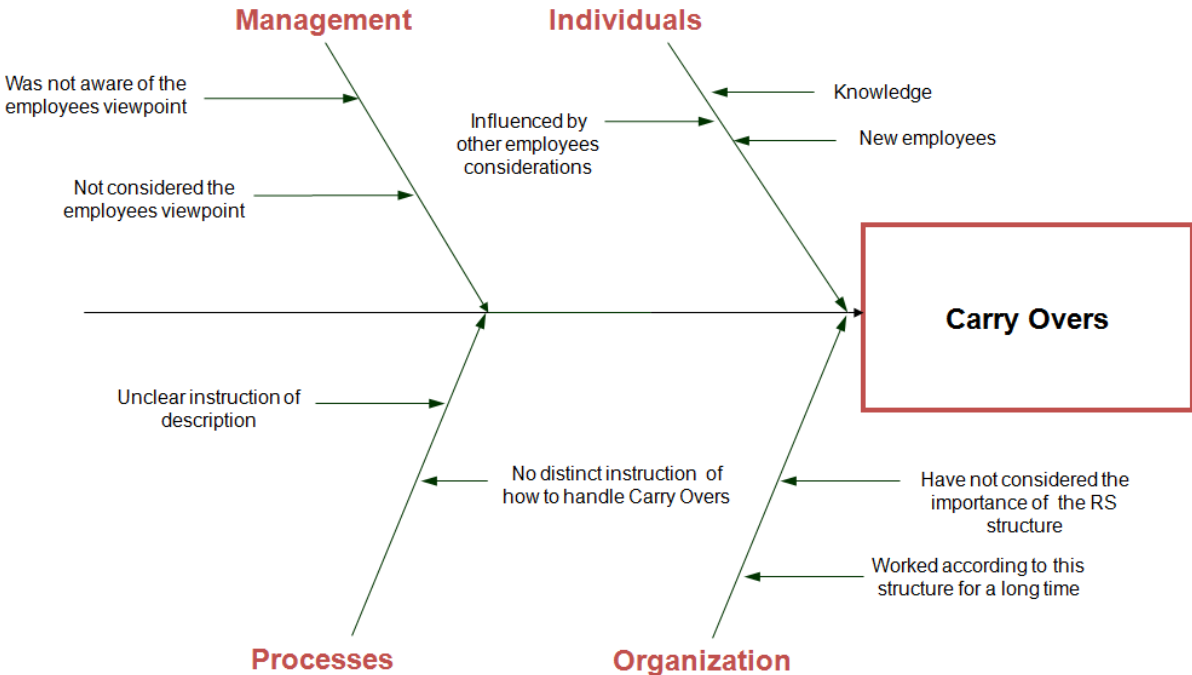


**Figure 25.** Cause and effect diagram of the "carry overs" issue.

*Management:* Might not have understood the magnitude of the "carry over" problems influence on projects and how they may affect the Feature Leaders work tasks as well as entire projects.

*Processes*: There is no distinct standardized way of how to handle and document the "carry overs".

*Organizations:* The organization might not have regarded the use of "carry overs" as a problem.

*Individuals:* It might be based on lack in knowledge of how to handle the "carry overs" among the employees, or even management. Information of the "carry over" is lost when employees quit and others replace them.

**The Balancing procedure**

In the survey, 70,5 % of the respondents in Gothenburg considered it unclear how the balancing procedure should be performed. In Ageo, 55 % and in Lyon 22 % believed that the process description is unclear, see Figure 26. The balancing procedure is part of the Systems Engineering process.
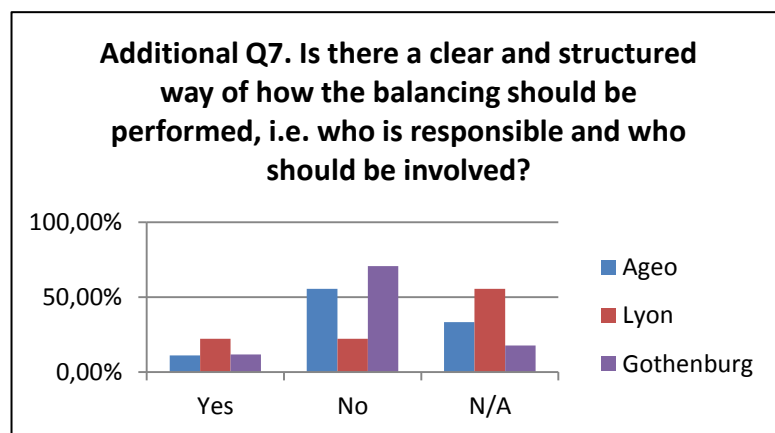


**Figure 26.** Diagram from the survey of the balancing issue.

The findings from the interviews, workshops and the survey summarized the causes of the balancing procedure problem:

- Feature Leaders experience that Project Managers perform the balancing procedure in projects and do not regard the Feature Leader´s inputs.
- The procedure is not well structured and the time planned for the balancing performance is insufficient. The procedure is differently performed in different projects and people often improvise.
- The template for the balancing procedure is not clear and quality secured.
- Feature Leaders regard the balancing process to not be part of their work tasks.

The balancing procedure issue has been evaluated and is illustrated in the cause and effect diagram in Figure 27.
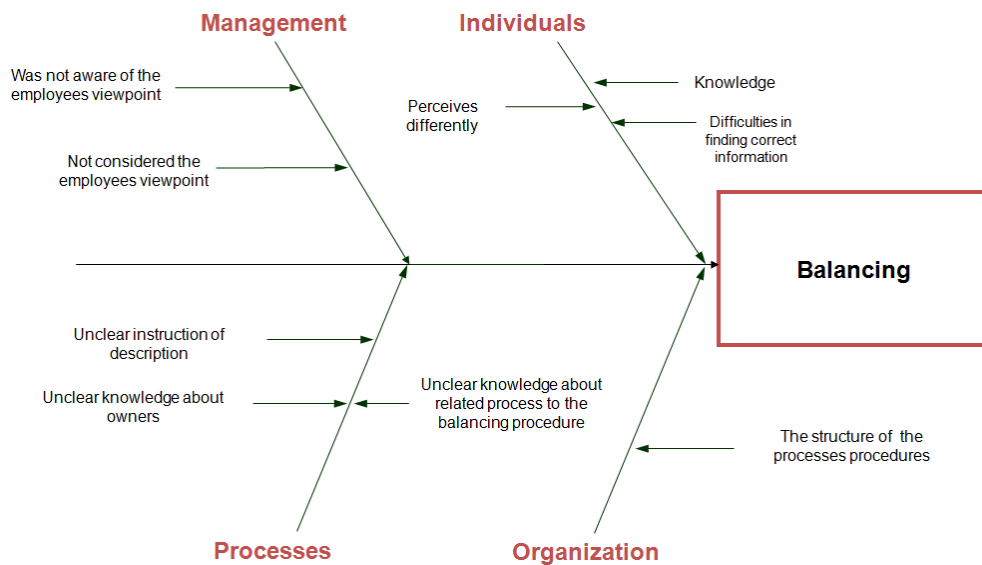
**Figure 27.** Cause and effect diagram of the balancing issue.

*Management:* Has not been informed of the Feature Leaders uncertainties regarding the balancing procedure structure. However, the information might have been distributed but has not been believed important.

*Processes:* No distinct description of how to perform the balancing process, including ownership and steps of performance has been provided.

*Organization*: The structure of the uniform instructions might not include all information that could be of interest to the performer.

*Individual*: Causes can be lack of knowledge of the balancing procedure, unawareness of where instructions are located and the fact that people interpret things differently.

**The use of the contract**

Today, contracts are used at Volvo GTT as representations of the final commitments on the requirements (regarded as driving the features) that will be delivered to the end customers. The contract is signed at FDCG by the stakeholders (FL, PPL, PDPM, CPM, PMFVV, and Brand) and involves the specification of the target vehicle, feature requirements, brand distinction, competitive set, technical description, project wanted position, the main driving targets, a short summary of the agreed sub features (the most relevant to highlight) and pre-requisites of the agreed sub-features versus the contract delivery of the selected agreed sub-features. The persons signing the contract are able to state comments regarding the contract contents.

Figure 28 shows the result of the Feature Leaders consideration of the contract use in projects. In Gothenburg 65 % and in Lyon 33 % of the respondents believed the contract to cause problem in their work. Ageo considered there to be no problems with the use of contracts.
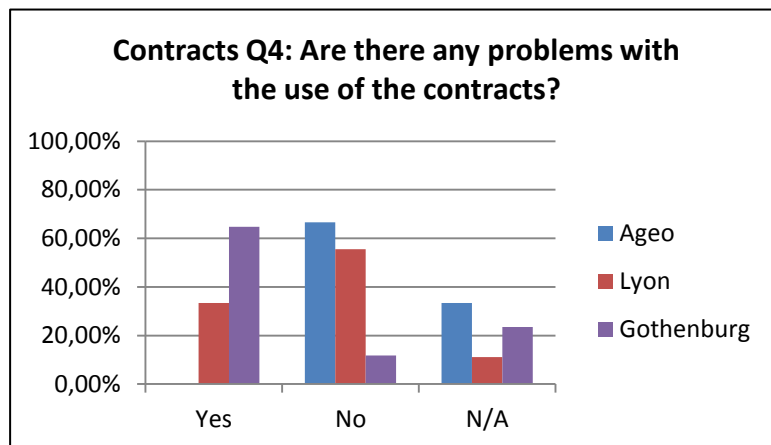
**Figure 28.** Diagram from the survey of the "use of contract" issue.

Below is a summary of the qualitative data from the survey regarding the use of the contract:

- The procedure of how to sign the contract and whom to send it to is unclear.
- The anchoring procedure is not established.
- It is unclear what signing the contract implies both for the project and for the people signing (among others, the Feature Leaders).
- There is a culture difference of the importance and function of the contract use.
- Due to cultural differences, people at some sites do not want to sign the contracts since they believe that they will be ultimately responsible for the contract contents.

The contract template has been evaluated based upon the findings from sessions with involved employees from Volvo GTT. Factors that affect the use of the contract at the same time as they do not correspond with its actual purpose have been identified and questioned and were expressed in a mind map, see Figure 29. The contract was also evaluated in a cause and effect analysis, see Figure 30, in which the root causes for the contract to be perceived as a problem were identified.
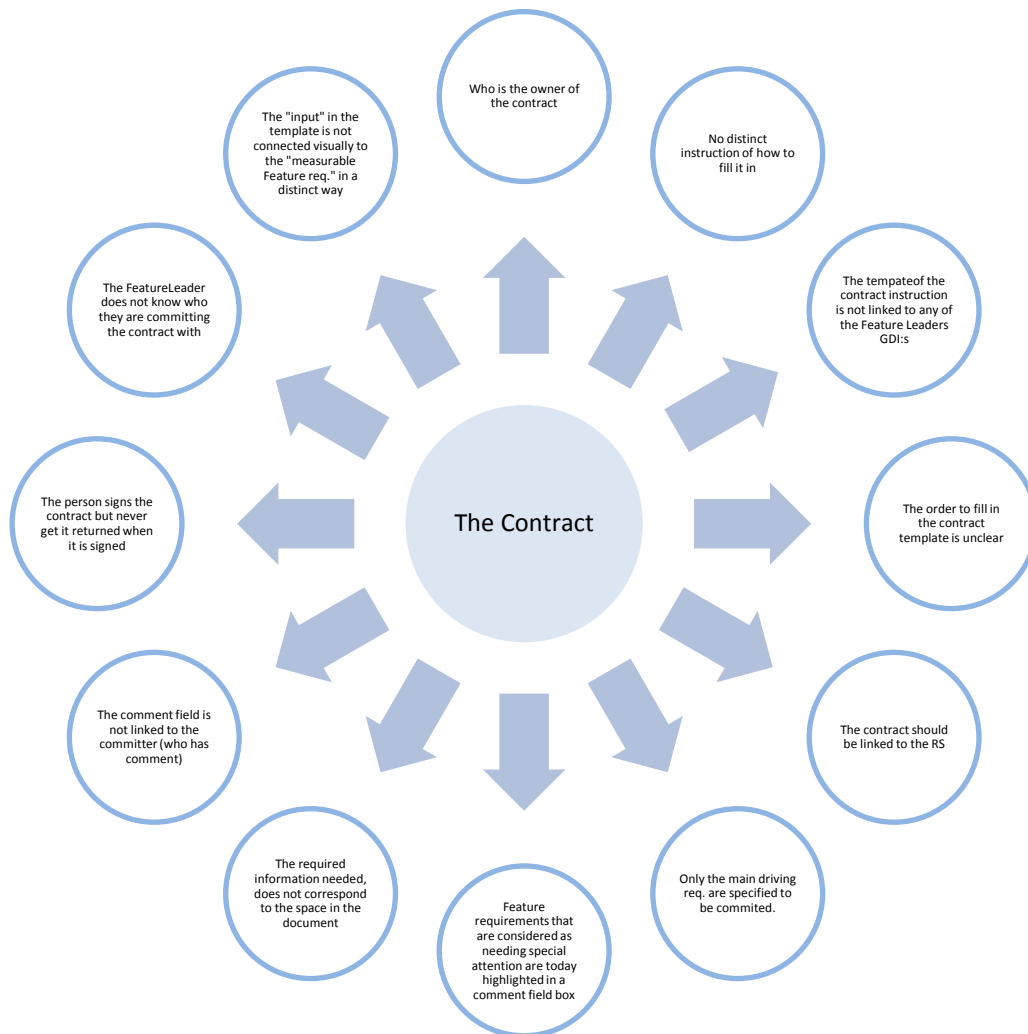
**Figure 29.** Mind map of the evaluation of the "use of contract" issue.

Layout:

- The logic in the design of the template could be illustrated in a better way. The boxes do not illustrate a distinct process of how to fill it in.

- There are not enough rows and space in the template for the needed/required information.

- The comment box in the "contract committed by" box should have its own row for each person signing, in order to clearly identify who has made the comment.

- The layout is too similar to the Feature Review template, which is filled in by Feature Leaders prior to gate status reporting.

Content:

- The contract does not include all the agreed requirements, only the agreed sub features or requirements that are regarded the most relevant to highlight.

- Information in the contract template is already stated in other documents, which leads to rework.

- If any features considered in need of more attention than others should be emphasized in the contract and not in the "comment box", as it is today.

The use:

- The contract should act as a final agreement of what will actually be delivered and not only cover the most relevant requirements.

- The information needed in the contract template should not cause a lot of rework for those who fill it in.

- The information should be obvious/understandable
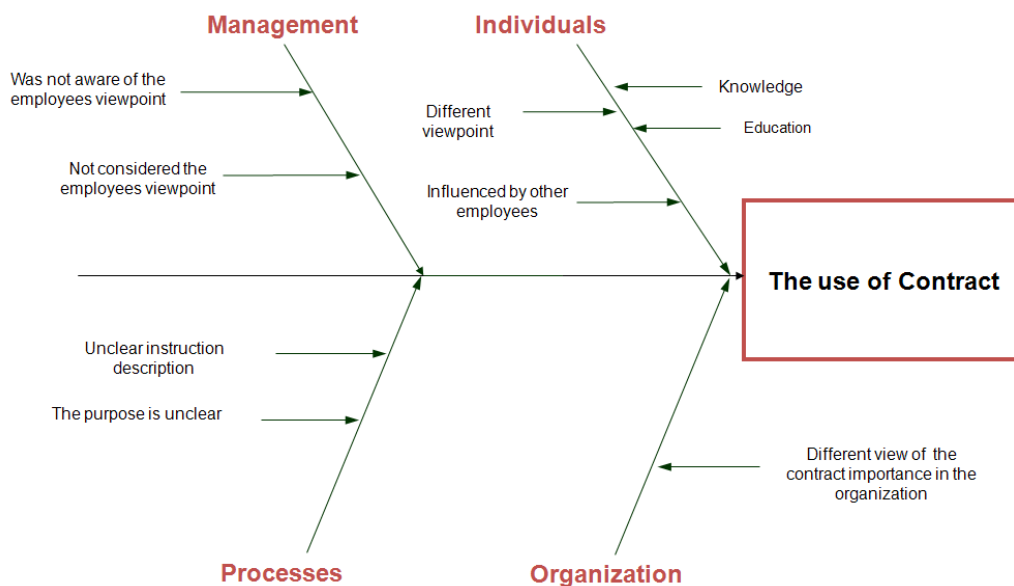


**Figure 30.** Cause and effect diagram of "the use of the contract" issue.

*Management:* Management has not regarded the subject important enough to be considered, or has not been informed about the Feature Leaders view on this issue.

*Processes:* The process does not describe the purpose or objective of the use of the contract in projects. The instruction might be unclear.

*Organization:* The view of the contract function is differently in different parts of the organization.

*Individual:* Employees have not been correctly informed about the purpose of the contract. People influence each other's viewpoints.

**Traffic Light**

Results from interviews, workshops and the survey, indicated that the use of the traffic lights when reporting status in projects are an issue that must be considered, see Figure 31. In Gothenburg, 65 % of the respondents answered that they considered there to be problems with the traffic light procedure. In Lyon, 33 % regarded it as a problem and nearly 12 % in Ageo.
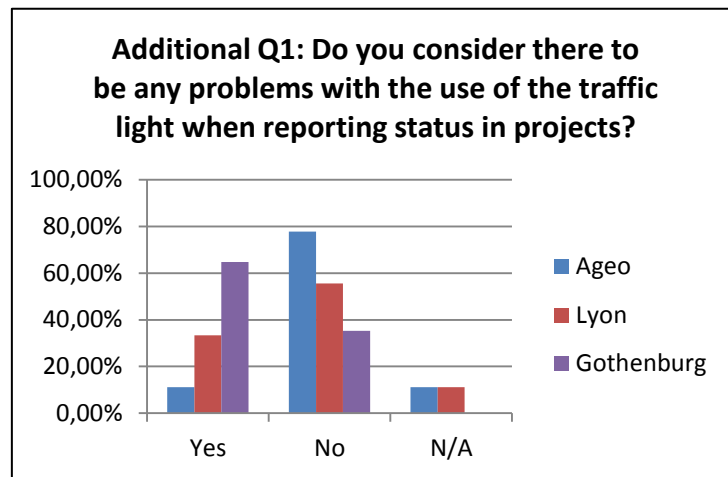


**Figure 31.** Diagram from the survey of the "use of traffic light" issue.

The qualitative data resulted in a summarized description of the Feature Leaders considerations regarding the traffic light:

- At Feature Reviews the colours of the status is more discussed than the actual problems identified.
- Some Feature Leaders do not have the experience to be able to set the correct traffic light colour.
- The projects are pushing for green status even if it has been set to red by the Feature Leader (many consider this action as just postponing the problem further).
- The definition of each colour is not clear and people interpret it differently.
- People set red at current status while they set green on forecasted SP status, which is a contradiction.

Based on the qualitative and quantitative result the identified issues have been evaluated in the cause and effect diagram in Figure 32. The causes of the problem have been stated and need to be evaluated further in order to be eliminated. Interesting areas related to Lean Product Development improvements are the lack in process description, communication, knowledge and Management involvement.
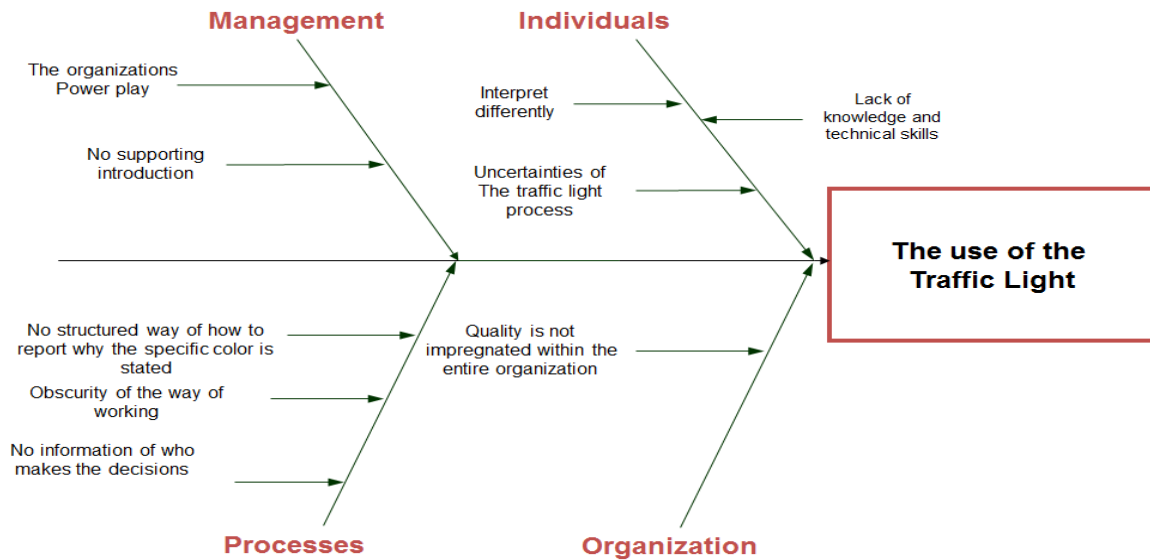
**Figure 32.** Cause and effect diagram of the "use of traffic light" issue.

*Management:* It might be based on poor introduction of the traffic light function towards the employees. People, interacting in projects do not consider the actual problem behind the red colour; it is more of a power play of prestige.

*Processes:* There is an unclear process description which is difficult to understand. There is no distinct instruction of responsibilities and decision making.

*Organization:* The level of quality in the organization is not secured and could be an influencing factor.

*Individuals:* Lack of knowledge or technical skills could cause the traffic light problem, but also that people interpret documents differently and feel insecure because they do not understand the traffic light system.

**Uninformed**

According to the survey, 47 % of the Feature Leaders in Gothenburg, 55 % in Ageo and 33 % in Lyon believed that the distribution of significant information towards the Feature Leaders is poor, see Figure 33.
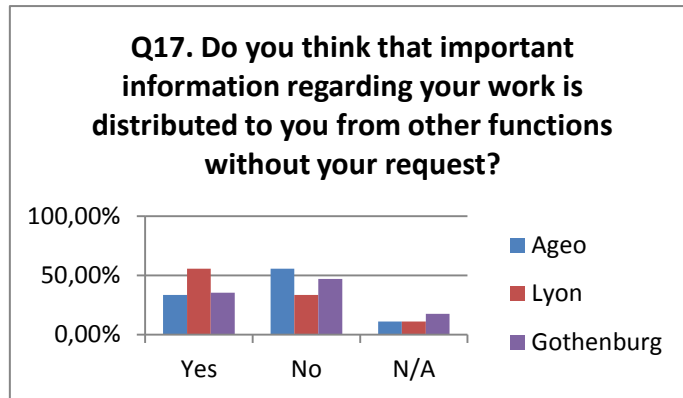


**Figure 33.** Diagram from the survey of the "uninformed" issue.

The qualitative result from the survey findings indicated that the Feature Leaders considers the procedure of distributing important information to be poor and can be summarized as:

- Feature Leaders must mainly request significant or updated information from other functions.
- New decisions (that affect a feature) and which are taken by the Design Engineer and the PPL are not always communicated to the Feature Leaders. It is believed that Design Engineering goes directly to PPL when they want a decision to be approved, without informing the Feature Leader. Consequently, in turn, it has been found from interviews that PPL do not want to transport information downwards in the hierarchy structure.
- Some functions/roles are not aware that the Feature Leader role is related to them
- Documents/decisions/updates that must be distributed to the Feature Leaders are not distributed, even though there are processes which specify that.

This problem has been analysed in the cause and effect diagram in Figure 34.
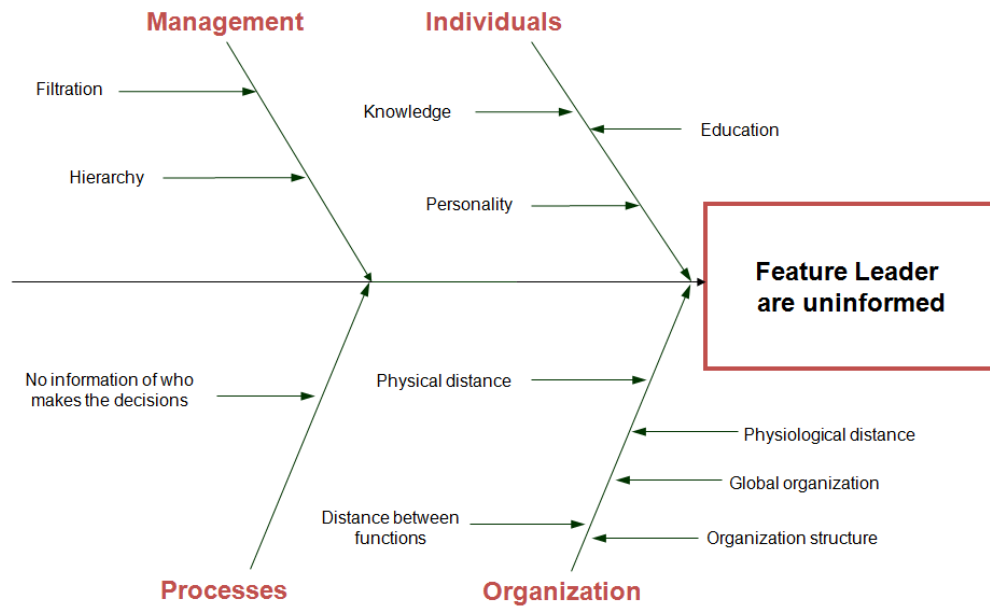
**Figure 34.** Cause and effect diagram of the "uninformed" issue.

It might be unclear how decision procedures are performed in projects due to uncertainty of how the process is formed and who is responsible.

*Organization:* The distance between departments, sites, language are factors that could affect the occurrence of the phenomenon.

*Individuals:* People from different backgrounds, organizations, industries and with different educations might have different attitudes to or knowledge about information distribution in the organization.

**Communication with SE, PPL and Design Engineering**

Communication is in the literature regarded as one of the quality dimensions, and it is therefore an important subject in Lean Product Development. The interaction with Systems Engineering, Product Planning and Design Engineering is critical in the perspective of a Feature Leader. The current situation of the Feature Leaders communication (at all sites) with the different functions (SE, PPL, Design Engineering) according to a survey performed in 2011, driven by Mr Pierre-Alain Makula – Chief Engineer Driver Productivity and Mr Anders B. Berle - Manager of Fuel Efficiency & Deputy Vehicle Productivity is displayed in Figure 35.

The survey performed in this Master Thesis resulted in the findings, see Figure 35, that the Feature Leaders consider the communication with the different functions to be inadequate, and that it therefore needs to be improved in all areas. The communication with PPL has the largest gap between the current situation and the desired situation. This indicates that there is a need to increase this communication in a qualitative perspective, while it is considered

92

important. Communication with Design Engineering and Systems Engineering also indicates the need to become more quality reliable and structured in a communication perspective.
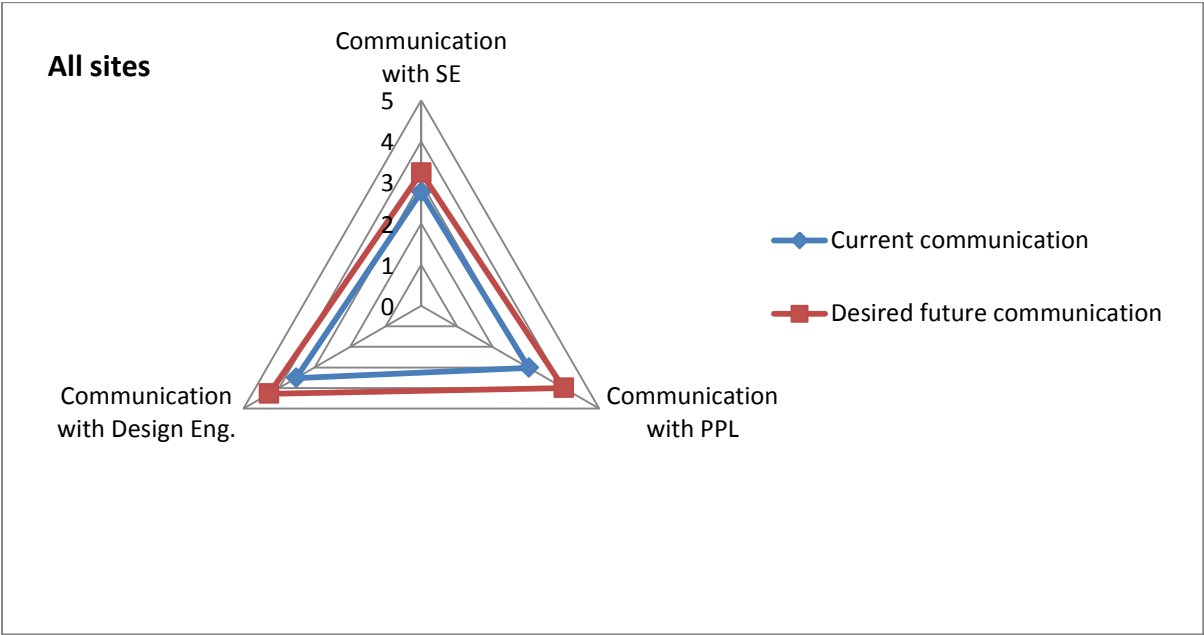


**Figure 35.** Current and desired future communication between Feature Leaders and SE, PPL and Design Engineers based on the survey from the sites Gothenburg, Lyon, Ageo and Greensboro.

The survey qualitative outcome regarding communication at all sites can be found below.

Communication between Feature Leader and PPL should increase because:

- Feature Leaders experience that they are uninformed about crucial information regarding their work in the overall interaction with Product Planning.
- Some Feature Leaders think that the communication is poor today, and they underline the importance of good and distinct communication.

Communication between Feature Leader and Design Engineering should be increased because:

- Feature Leaders and Design Engineering must have a better interaction due to the importance of communicating requirements in order to be able to discuss solutions.
- Feature Leaders experience that the Design Engineers "walk around" their role as a Feature Leader.

Communication between Feature Leader and Systems Engineering should be increased because:

- On some occasions it has been found that Systems Engineering ignores the Feature Leaders input regarding which of the overall requirements shall be specified in the Requirement Specification. Consequently, critical overall requirements are disregarded and important information is lost.

- There have been occasions when System Engineering together with other roles change/exclude requirements from the project without informing the Feature Leaders about it.

The poor communication is partly caused by the fact that the employees are not aware of what other functions are actually active in a project. Employees do not have the entire view of how a project is performed and they are not aware of where other functions critical/major work tasks in a project occur. This was mainly discovered in the value stream mapping process.
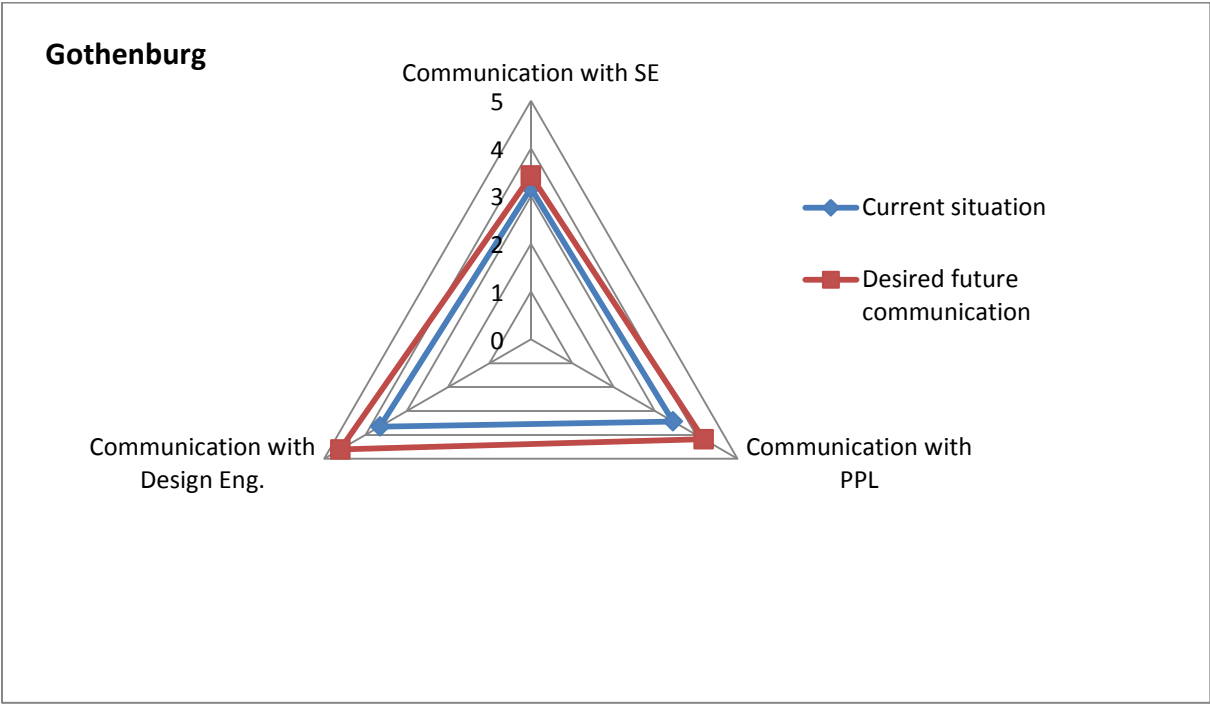


**Figure 36.** Current and desired future communication between Feature Leaders and SE, PPL, and Design Engineers based on the survey from Gothenburg.

As visualized in Figure 37, the Feature Leaders believe that they spend 50 % of their time in Gothenburg, 35 % in Lyon and 10 % in Ageo on non-value adding activities when interacting with Systems Engineering. Regarding the interaction and communication with Design Engineering, 30 % of the time spent in Gothenburg, 30 % in Lyon and 62 % in Ageo was considered not to add value. The corresponding numbers for communication with PPL was 37 % in Gothenburg, 42 % in Lyon and 62 % in Ageo. This can be related to the desire to increase the quality of communication with the concerned functions.
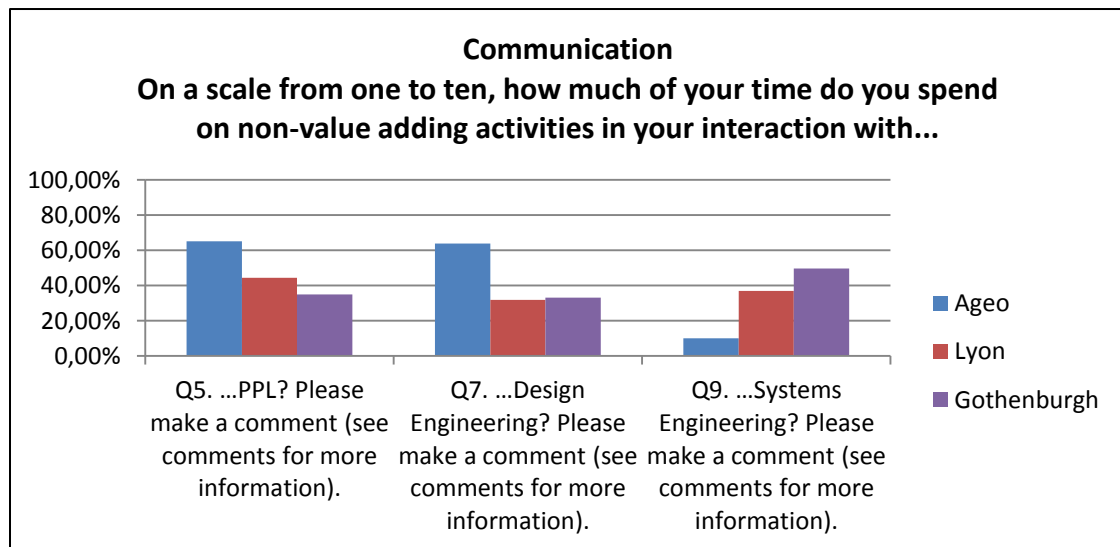
**Figure 37.** Diagram from the survey of "how much non-value adding activities" when interacting with SE, PPL and Design Engineers as a Feature Leader.

## 9.6 Additional problems identified

In addition to the critical findings from the interviews and the survey, other crucial areas which influence the quality in the work have been identified.

The following concerning the Feature Leaders work and surroundings are considered non-Lean at Volvo GTT:

- The abbreviations of different terms in the organization are not correctly used or correctly defined by the employees. People are using abbreviations when communicating without knowing their meanings.

- Employees do not follow the available standardized documented processes.

  o Project Managers set their own processes within the GDP.

  o Feature Leaders use different documents for the same purpose when they distribute requirements on different levels to SE.

  o Design Engineering starts their work without the Feature Leaders being aware of it, and without specified requirements.

- Tools do not conform to the organizations processes. The Requirement Specification is expressed in Microsoft Excel and has been rejected by a majority of the participants as not being distinctive.

- Today, no procedure explains how the Feature Leaders should work with continuously improvements in the organization. There is no official structured way for how to propose improvements. Feature Leaders consider the FLGOT forum as a significant meeting. However, Feature Leaders participating at FLGOT consider they

do not get the chance to speak out, and/or they think that all considerations are not taking into account.

- The advanced engineering (AE) projects (RnD) are today performed in parallel with the customer focused projects.

- Poor delegation of resources in specific quality related areas, such as competition analysis.

## 9.7 Current problem solving methodologies at Volvo GTT

The conflict and problem solving methodologies at Volvo GTT with a focus on the Feature Leader environment have been evaluated on basis of a group interview session. The process description of the GDP says that a White Book (lesson learned document) should be produced at the end of each project, since that is an efficient way to learn from mistakes and successful events and results. However, the White Books do not seem to be updated and used as they are intended to. Some Feature Leaders have never received any feedback on the content in the White Book and do not know where it is located in the database. Lesson Learned is an efficient methodology if it is used correctly and could be a foundation of how to improve in the next project. It must be visualized and used. When a conflict or a problem is identified the employee discusses the issue with the group members. Consequently, the employee states the issue identified to the manager, sporadically. Many of the identified issues are solved on the initiative of individuals. However, it is not clear who the intended owner or person responsible for action is.

The processes of how to solve conflicts and problems must be improved. Feedback on the stated problems is not prioritized and might in some situations disappear, due to poor responsibility delegations. People are afraid to take action and no one has the courage to take the first step.

## 9.8 FL Training Material

In line with the scope, the FL Training Material was reviewed and updated based on interviews with Feature Leaders (who have worked in the organization for eight months, five and ten years respectively), regarding the FL Training Material (see chapter 8.1 *Individual interviews*).

Reveal that their main considerations are:

- Today the training material consists of three different parts including 119 PowerPoint slides. The material is too extensive and must be compressed.
- The information was found to be unclear in some areas.
- Some parts have illogical in the structure.
- The slides contain a lot of information in both text and pictures which is difficult to orient in.
- There is no real common thread in the storyline.

It should furthermore be emphasized that the existing FL Training Material has not been distributed to all Feature Leaders during the years. The survey, see Figure 38, confirms that the FL Leaders awareness of its existence is low.
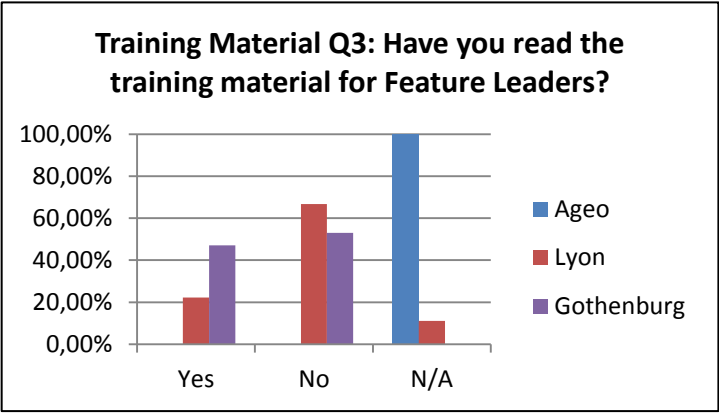


**Figure 38.** Diagram from the survey of how many Feature Leaders that have read the existing training material.

## 9.9 Value Stream Mapping of the Feature Development Process – information flow and FL role activities

The Feature deliverables flowchart describes the activities needed for the development of a feature throughout a project. The activities are mainly performed by the Feature Leaders but some are also performed by other functions. The result from the comparison of the Value Stream Mapping with the documented Feature Development Process showed differences, see Figure 39 and 40.

The comparison shows that some activities in the early phases are performed by other functions. Some of the activities in the "Outcome from Feature Leader" column are in reality outputs from other functions and actually inputs to the Feature Leader.

The Feature deliverables flowchart is, by regulation, meant to only specify activities inside projects. However, it also contains activities that the Feature Leader is responsible to perform outside the project. The suggested update of the Feature deliverables flowchart all lists all activities whether they are performed in product related projects or not. It is clearly stated whether this is the case or not.

The Feature deliverables flowchart not explains the activities in detail nor describes function ownership of them. It further does not describe the Feature Leader activities outside the FDP. The activities in the flowchart are very briefly formulated, which makes them partly difficult to understand.
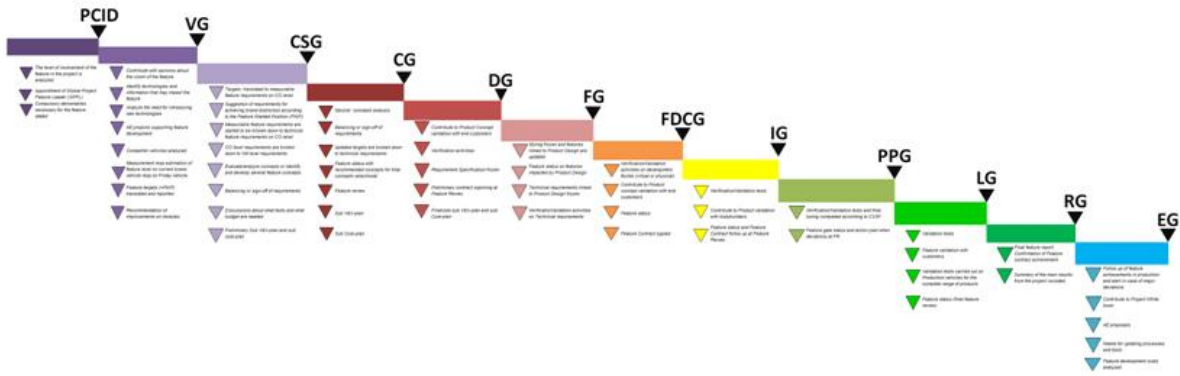
**Figure 39.** The activities included in the present Feature deliverables flowchart.
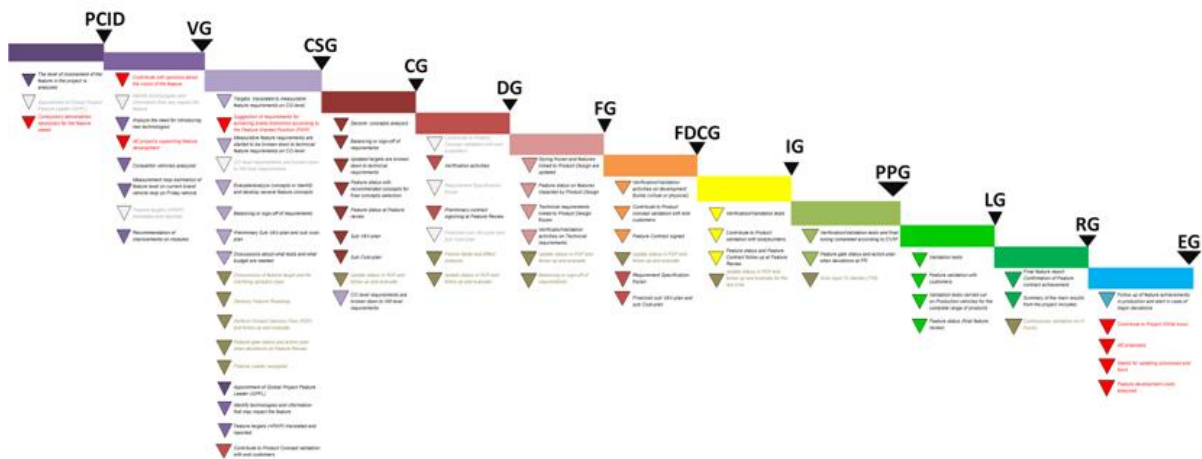


**Figure 40.** A comparison between the existing Feature deliverables flowchart and the mapped situation. Red activities are not performed, grey activities are performed later or earlier than intended, and brown activities are not included but are sometimes carried out.

It was discovered that some activities in the Feature deliverables flowchart are not performed at all, and that some are performed later or earlier than intended. Some of those that according to the VSM are performed today are not included in the Feature deliverables flowchart. All these activities are listed below in sequence. Each list explains why the activities are not at all performed, performed later, earlier than intended, or are not included in the Feature deliverables flowchart.

➤ Activities that are not performed:

1. *List of compulsory deliverables* is not performed today according to the VSM. The explanation can be that the VSM is performed on five out of thirty-two features, and that the people interacting in the workshop have not seen it happen in projects.

2. *Contribution with opinions about the vision of the feature, and what improvements are needed for reaching the feature vision,* is not an activity that is

98

performed today according to the VSM. Interviews indicate that the Vision of the Feature is not an outcome provided by the Feature Leader, but an input to the Feature Leader from Product Planning (PPL).

3. *Advanced Engineering (AE)* is usually not performed to the extent necessary. The major reason is that there are no resources for AE work in projects.

4. *Give suggestions how Brand distinction can be achieved,* is according to the VSM and interviews not performed by the Feature Leaders. The reason is that there is not enough time for this activity.

5. *Contribution to the Project White Book,* is according to the interviewed Feature Leaders not an activity that they perform for all projects. The main reason seems to be lack of time and interest, in both Feature Leader and manager perspective.

6. *Learning from experience* is neither documented nor analysed since there is no time for evaluation. Knowledge from previous projects is not distributed further. At present time plans are not updated and AE proposals are not made.

➢ Activities that are performed later than intended according to the Feature deliverables flowchart:

7. *Appointment of Global Project Feature Leader (GPFL) by Line organization* takes place prior to CSG instead of prior to VG in the existing flowchart. The reason is that the Line organization does not believe that the GPFL and FL have to be assigned prior to VG. This can be due to misunderstandings of the process.

8. *Identification of technologies and information that may impact the* feature and *Analysis of the need for introducing new technologies to reach feature vision.* These activities are according to the VSM performed prior to CSG, instead of prior to VG in the existing flowchart. The major reason for this is probably that the Feature Leader in reality is not involved as early as prior to VG.

9. *Competitor analysis* is rarely carried out according to the process mapping. If it does happen, it is usually later in the project than prior to VG. The analysis should mainly be performed in a separate Competitor Vehicles Analysis (CVA). This is referred to projects that are product related and require an extra competitor analysis. In some situation the Feature Leaders are involved in several projects in parallel. So if a competitor analysis is financed by one project prior to VG the Feature Leader brings the knowledge gained to the other projects that might be in later phases. Another reason is that there are no allocated resources and budget to finance the CVA.

10. *Translation of feature targets (PWP)* cannot be performed by the Feature Leader before they are assigned and involved in the project, which they usually are after VG. Translation of targets is not made prior to VG according to the VSM.

11. *CO level requirement break down to VM level requirements* and *Agreement with Engineering on the level of requirement break down* starts prior to CG instead of prior to CSG. This is probably a consequence of previous activities being performed later than intended.

12. *Freeze of the Requirement Specification* takes place at FDCG and not at DG. The Requirement Specification (RS) is frozen at FDCG when the feature contract is signed by the stakeholders. However, even after FDCG, deviations occur and the Requirement Specification can be updated.

13. *The sub-V&V plan* and *sub-Cost plan* are in reality frozen/finalized prior to FDCG and not at DG as directed in the flowchart.

➢ Activities performed earlier than intended according to the Feature deliverables flowchart:

14. *Feature gate status and action plan when deviations*. According to the VSM Feature Review starts to occur prior to CSG.

15. *Contribution to validation of concepts with end customers* might start already prior to CSG for some features instead prior to DG. For e.g. Driver Interface, it is possible to make early validation with end customers already prior to CSG. This is due to that several concepts can be developed rather early since the concept development consists of e.g. simulations. For features that require more advanced calculations, the concept development and concept validation cannot be done until later in projects.

➢ Activities that are not included in the existing Feature deliverables flowchart but that sometimes occur:

16. *Feature leader assigned for features that are involved in the project*.

17. *Discussions of feature target & Discussions to clarify the scope*.

18. *Feature Roadmap* and *Feature Development Document* are developed/updated together with PPL. The development of the two documents is an iterative process. This activity is not performed within projects, which probably is the reason to not be included in the flowchart. However, it is an outcome from the VSM and has been considered important to state.

19. *Perform Project delivery Plan (PDP) and PDP status (Follow up and evaluate) updated prior to each gate until IG.* The PDP has not been thoroughly implemented and therefore not used frequently. However, it is at the moment being updated in the lead time reduction programme RnD30.

20. *Participate in sign-off and/or balancing of requirements* is not included in the existing Feature development flowchart prior to Freeze Gate. This activity is performed according to the VSM.

21. *Give input to market (ITM)*. This activity is not performed within projects, which probably is the reason of not being included in the flowchart. However, it is considered as important and has therefore been added to this list.

22. Continuously validation on P-trucks. This activity was according to the VSM not performed.

**Additional reasons for why activities are not performed as intended in the Feature deliverables flowchart:**

Competitor analysis is supposed to mainly be performed in certain Competitor analysis projects. However, if competitor analysis has not been performed sufficiently outside projects the Feature Leader shall initiate competitor analysis within projects if needed.

Research and development related activities are supposed to be performed outside projects in certain AE projects. The omission of not performing Competitor Analysis or AE cannot be blamed on the project. It is rather directed towards the project that provides budget and ensures the stated activities are performed. However, it is still important to emphasize that the Feature Leaders do not perform all the activities that they considering necessary for performing their work tasks within projects in an appeaseable way. It contributes to difficulties to report on feature status regarding the competitors' positions. Further it aggravates the Feature Leaders' possibilities to evaluate the feature in a subjective and objective way.

It can be stated as an overall observation that activities are rather performed later than earlier than intended. A reason for this can be that the Feature Leader is involved too late in projects which consequently follow the first activities being delayed and following activities will be postponed as well. There are not enough resources available corresponding the actual need.

Overall, the Feature Leaders consider that they do not have time to perform their activities of responsibilities outside projects. This is an issue, especially regarding consultants', sense they are required to register which project they are working in, and they are also allocated a very small amount of time for work outside projects. The only way for them to manage to perform the outside projects activities are to do so-called "black market work". That is work that is not related to a specific project, but the time for its execution is anyway registered on a project, which submitting false data of the actually resources needed.

It should be emphasized that the VSM was performed on five out of 34 features. The features are unequal in their characteristics and when different activities are performed in a project. The selection of these five features was based upon the intention to represent all categories of features. This implies that activities listed in the updated flowchart as "not performed" or as "performed later than intended" is based on the information gathered from those features. It is possible that the activities that are in the list of "not performed"

activities actually are performed but have been considered by participants as not being executed. This can be due to misunderstandings or that the participants in the VSM session did not think of these activities during the mapping procedure. However, regardless the situation it is still critical that these activities are underlined. If they could not be identified in the comparison between the feature deliverables flowchart and the VSM, it implies that the flowchart is not stated in a language that is daily used by the Feature Leaders. It is also important that activities that the comparison indicate as performed later than intended, but which according to some features are performed as the Feature deliverables flowchart intends, are pointed out. These activities need to be overviewed and updated in the Feature deliverables flowchart so that it is generic and suitable for all features.

### 9.9.1   Information Flow

The result from the VSM showed that the information usually is distributed by direct communication, by telephone, e-mails, or via communicator. Information for Feature Review and gate status, Verification & Validation plan, and Cost plan have certain templates that are used.

> ➤ The information flow between the Feature Leader and the related functions: PPL, FCT, PMQ, PSL, PDPM, Group Manager, manufacturing, Quality, Line Organization, Engineering, PM FVV, Brand, CPM, PAM, RM,  SE, $CV^3P$, FDP and PPL has been established in a Feature Leader Role flowchart. The different activities link to the processes System Engineering (SE), Product Planning (PPL) and $CV^3P$ are stated in the flowchart. The proposed flowchart of the Feature Leader role illustrates the processes locations of the activities performed.

# 10 Proposed solutions for identified conflicts & contradictions

This section describes the solutions proposed for the main conflicts/contradictions and problems identified.

## 10.1 Carry overs

The majority of the Feature Leaders think it is a problem how "carry overs" are handled. It has also been evaluated that "carry overs" could have an impact on the efficiency of project processes at Volvo GTT. The Requirement Specification is a document that cannot handle all the requirements including the "carry overs" in a project. However, the connection between the Requirement Specification and the "carry overs" must be handled somewhere.

The proposed solution is to state "carry over" requirements in a customized database for each feature which the Feature Leader is responsible for. The database should also include the new requirements on complete offer level as well as on vehicle module level. In this way, the Feature Leader is able to control, handle and reuse feature requirements for each project including the "carry overs". Requirements once stated are documented in the database and does not need to be specified again. It gives the Feature Leader the opportunity to distribute technical requirements to the Design Engineers and they will have the overall view of the project requirements. The Design Engineer with support from Feature Leader has the responsibility to state status colour red, yellow or green on the requirements fulfilment which helps the Feature Leader control the requirements fulfilment. When changes are made and new solutions are constructed it is more obvious for the project members how the new solutions are connected to the new and old requirements (the "carry overs").

This approach is more or less already used within the Ergonomic features at Volvo GTT. They have evaluated and developed an Excel database that they call ERS (Ergonomic Requirement Specification). In the database they work similar according to the description in this text and have successfully implemented the process within their group.

## 10.2 Balancing procedure

The balancing process instruction has been stated to lack in distinctiveness. The balancing procedure is a part of the Systems Engineering process and an established instruction is available on Team Place. However, a number of the Feature Leaders have not read the Systems Engineering process description. The Feature Development Process only states that the balancing process is performed and is linked to the Systems Engineering process and does not describe it as a procedure that he Feature Leader should participate in.

The proposals for the balancing procedure issue are:

➢ Clarify the balancing process performance in the Feature Development Process document: who the owner is, where it is located, what the main tasks to perform are in the balancing process as a Feature Leader.

- ➢ Establish an updated distinct process flow, step by step, of the balancing procedure in the Systems Engineering process instruction.

- ➢ Implement a more detailed description of the Feature Leaders activities including the balancing process as for example the Feature Leader Role flowchart established by this project (see chapter 10.6). Among other things, the Feature Leader Role flowchart will contribute with a better understanding and when balancing procedures are performed in projects for the Feature Leaders.

## 10.3 The Contract

The results from the interviews, the workshops, and the survey show that there is an unclear view and understanding of the contract functions, use and purpose. A proposed solution is to add the updated contract template instruction developed in this project to the contract template. The updated instruction describes the contract's aim and objective and is more structured than the existing instruction.

However, the updated contract instruction does not solve all problems with the contract, it is still lacking in perspective of its layout, content and its use. A new template called "Final Agreement template" (see Appendix H) has therefore been established based upon the evaluation presented in chapter 9.5 and a second proposed solution is that Volvo GTT to consider it.  An instruction of the procedure of how to fill in the template is described in Figure 41 and the signing process is described in Figure 42 and in Appendix I.

**Proposed new version of the contract template and its anchoring process**

**The name of the template**

1. The name "contract" has been indicated by many Feature Leaders to mediate contingency towards its purpose, see Appendix C (the result from the survey).
   - ➢ **Proposed solution:** During a project its stakeholders agrees upon new and updated requirements by signing "Sign offs". The name of the proposed new template is "Final Agreement" since it is the final "Sign off". The words of "Final Agreement" have the same object and magnitude as the name "Contract" but will contribute to a more natural transition by "committing to a final agreement", than to a "contract and may give the people involved the correct understanding of its purpose and function.

**The construction and anchoring process**

2. Today, the requirements that are balanced are just changed to a new "value" in the Requirement Specification without a notation that those requirements have been balanced. Hence all balanced requirements today needs to be stated in the contract template.
   - ➢ **Proposed solution:**  Add an extra column is added in the Requirement Specification, describing that the requirement has been changed from the original target to a new target. This will help the project to trace balanced requirements if. Hence, there is no need to specify the balanced requirements in the "contract" template. By using a filtering function in the Requirement Specification, it is easy to collect the balanced

requirements if needed. When signing the Final Agreement, it is the Requirement Specification that is the document to be committed. What the customers are expecting and what the stakeholders are signing are both connected to the Requirement Specification.

3. Today, every "contract" of the 34 features that has been signed is distributed to the same function, the CPM. This contribute to a massive transportation of 34 different contracts that are about to be gathered into the project description report by CPM.

   ➢ **Proposed solution:** When a new project starts, add a new folder at a special forum e.g. Team Place in which the persons and stakeholders that will later sign the Final Agreement at FDCG are specified. This information must be available early in projects since it is important to be aware of who will sign the Final Agreement. The folder contains folders for all the different features. When a Feature Leader has established the Final Agreement document, he/she uploads it to the folder corresponding his/hers feature. Then the stakeholders can enter the corresponding folder and sign the Final Agreement. There are two alternative ways to inform the stakeholders that they need to enter the corresponding folder: 1. There is a list in the folder of the stakeholders' names. The Feature Leader copies the list and sends the information by e-mail to the signers, that the Final Agreement document is located in the shared folder. 2. Automatically e-mails are sent to the persons that have been specified as stakeholders to sign the Final Agreement.
   By adopting this method, the Feature Leaders do not have to search for people in the organization and send the agreement around to different functions. The CPM that receives all the 34 Final Agreements can control the collection in a smoother way by just entering the different folders and gather the information needed to put in the project description. All functions as well as other involved in a project are able to enter the folder for a specific feature to view the Final Agreement document.

The purpose of the existing "Contract" is to act as a document that will describe what will be delivered to the customers. Therefore it is not enough to only specify different chosen requirements in the Final Agreement template. All the requirements must be specified to describe the end product that will be delivered, which require all requirements to be stated. In the proposed Final Agreement template the Requirement Specification act as the foundation of what are about to be signed. All requirements are included as well as the balanced and main driving ones. In the Final Agreement document the Requirement Specification document issue number is referred to and its contents that are to be signed. The Final Agreement template has been developed and formed based on the existing "Contract" template. The construction and signing of the Final Agreement procedure is visualized in Figure 41. Important information in the existing contract template has not been rejected in the new Final Agreement document, but has been specified in another way. Information as "Target vehicle", "Feature requirements and brand distinction", "Competitive set" and "Technical Description" are stated in the Feature Status template at Feature Reviews during the project. It was determined that this information does not need to be stated once again in the Final Agreement document.
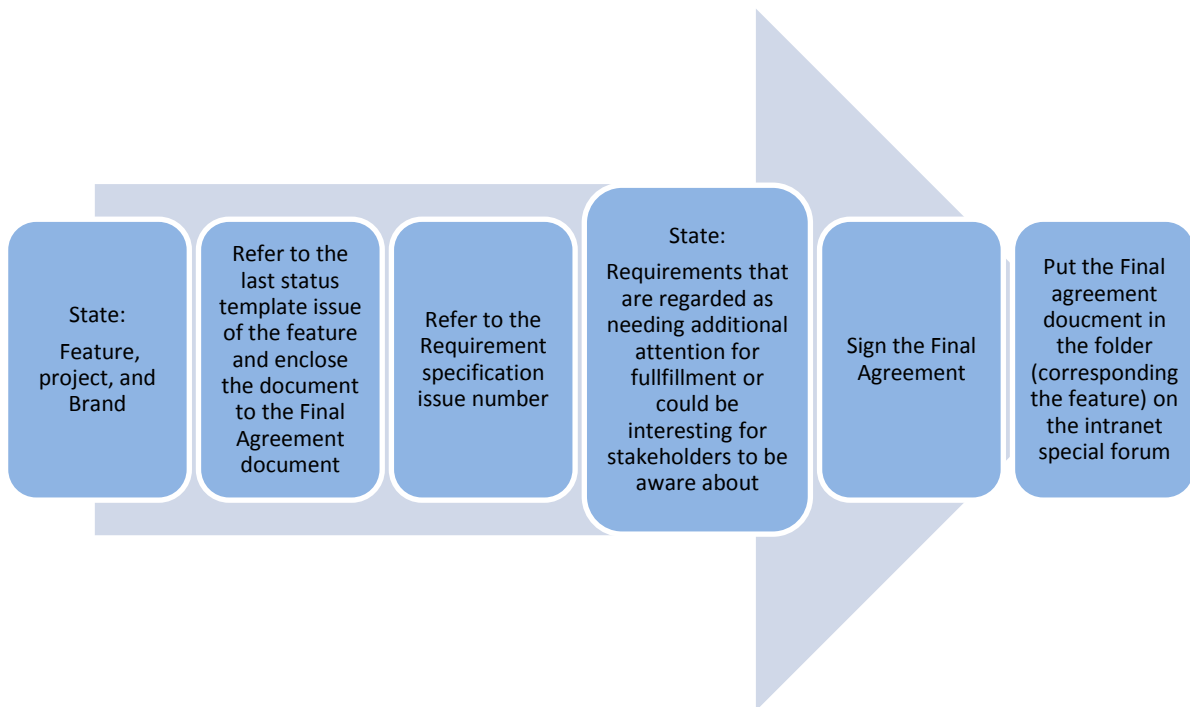
**Figure 41.** The "Final Agreement" construction and signing process.
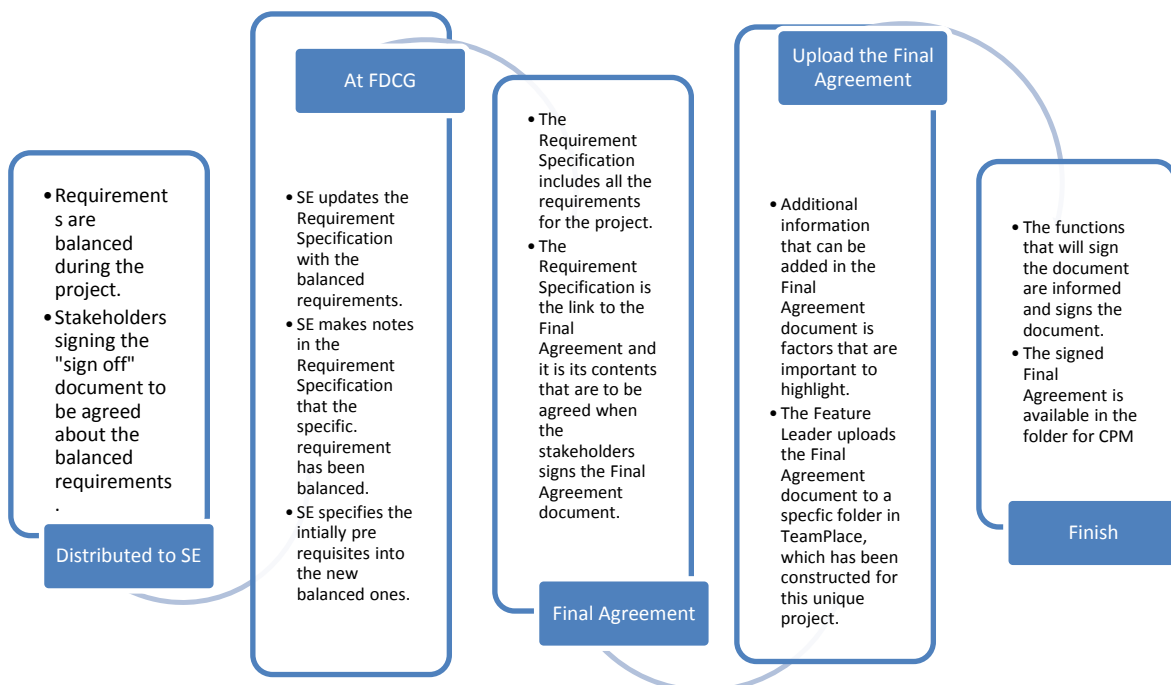


**Figure 42.** "Final Agreement" document signing process and anchoring procedure.

## 10.4 Methodology of solving conflicts/contradictions

The root causes of conflicts and problems must be determined in order to create an organization based on quality. The awareness of the current situation and the conflicts that counsels is critical in order to become successful.

Different crucial factors that need to be improved when solving conflicts and contradictions are:

> ➤ The establishment of roles responsibilities of different activities must be clearly stated in the processes. A distinct description and delegation of responsibilities will eliminate misunderstandings and provide a higher level of awareness.

> ➤ The possibility for employees to be able to state their concerns in a qualitative way must be revealed. The process of this procedure should be clearly described and secured. Internal benchmarking is a procedure that will make it possible for Feature Leaders to exchange information and knowledge, which will increase the internal knowledge sharing. The organization should focus more on long term knowledge e.g. considering the importance of AE projects, in order to achieve a proactive thinking. Conflicts regarding the feature development work could be reduced by underlining the importance of invest in education.

Conflicts and problems that arise based on insufficient work tasks must be documented and solved. It has been suggested by employees' interviewed to use the FMEA method focusing on the work task environment. The method includes stating happenings that risk to occur which can affect the work tasks and the project outcome. Each error regarding the work is stated in a PROTUS report, in order to make it possible to follow up problems in the operations.

## 10.5 FL Training Material

The results from the survey and interviews regarding the FL Training Material showed that the existing FL Training Material has vague formulations, repeated facts, and inconsistent and blurred figures.

> ➤ **Proposed solution:** Overview and implement the proposed update of the FL Training material. Its layout and structure is more distinct and has been considered and updated based on information from the former training material, information from GDI:s, and the intranet.
>
>   It is important that the FL Training Material is provided to the Feature Leaders at all four sites and that they are informed about where the material can be found. Further, a proposal is to record a voice that explains the content in the material as a recorded lecture. This could ensure that new Feature Leaders gets a proper introduction to the Feature Leader work, even if no one has the time to introduce them and go through the material when they start. The material shall also help Feature Leaders in their work. The front page of the updated FL Training Material can be viewed in Figure 43.

**Figure 43.** Updated Feature Leader Training Material

## 10.6 Feature Development Process

The result from the comparison between the VSM and the existing Feature deliverables flowchart indicated that some activities included in the existing flowchart are generally performed outside product development projects, while several activities that in reality are done in projects are excluded. Furthermore, several activities are in reality performed later, earlier, or not at all. Some of the activities are not Feature Leader responsibilities and the activities are vaguely described.

➢ **Proposed solution:** Overview the suggested changes of the flowchart provided by this Master Thesis. The changes are based on the results from the comparison between the Value Stream Mapping and the Feature deliverables flowchart. It should be emphasized that the process mapping performed involved five different features and since there are thirty-four features there can still be some features that are not covered by proposed changes in the Feature deliverables flowchart.

Suggested changes and considerations of the flowchart:

▪ A column is added to the flowchart, with information of whether the activity is performed within or outside projects. It was considered that some activities were important to state in perspective of the feature development, even if they are performed outside a product related project.

▪ Activities that are not included in the existing flowchart, but which are important in a feature perspective, are added.

▪ The activities that are performed later, earlier, or not at all are indicated in the suggested changes of the flowchart.

▪ The *input to* and the *output from* the Feature Leader is updated to correspond to reality.

▪ The formulations are stated in a clearer way in the proposed changes of the Feature deliverables flowchart even if it implies that they have to be longer.

108

- The activities in the updated flowchart are stated prior to a specific gate so that the flowchart mirrors how the activities and gates occur in time.

- The flowchart takes into account that the features are constituted by different characteristics and activities might be performed differently in time perspective for different features.

Furthermore the result showed that the Feature deliverables flowchart does not state the owner of the activity and does not cover all the activities that the Feature Leaders perform that belongs to other processes such as CV$^3$P and SE.

- ➢ **Proposed solution:** Since it might not be clear to all Feature Leaders, especially not to new Feature Leaders, which process that describes a certain activity one major need is an updated Feature Role Description. Today it does only shortly explain the expectations of a Feature Leader. The proposed solution for ensuring that the Feature Leaders are aware of all the activities that they are expected to perform is to implement a Feature Leader Role flowchart which has been established. It describes the inputs to as well as the outputs from the Feature Leader. In difference from the Feature deliverables flowchart it does describe which function who owns the activity, which process the activity belongs to, and states all the activities that the Feature Leader performs during a project.

## 10.7 Proposed methodologies

Based on the result in this report, it has been considered that there is a need of methodologies to enhance improving. Action must be taken in order to reduce the waste identified in the feature area at Volvo GTT. To strive for the future position within Lean thinking (stated in chapter 9) it is proposed to view and adapt the methodologies "Visual Planning" and "Improvement Board" which are described below.

These methodologies are ways to become more efficient and to ensure that the projects in the organization are run accordingly quality thinking. In long term perspective it is recommended to implement these approaches into the organization. They will together contribute to a proactive way of working and are essential for Lean improvement work. However, what must be underlined is the significance of dividing the long term goals into short term achievable objectives. Each one of them needs the time to be understood, evaluated to suit the group and department, and accepted and implemented by the managers and employees. It is a step by step programme with the importance of involving the employees in an early stage in order to succeed.

### 10.7.1 Visual Planning

Involved functions in projects do not have the same view of the processes. The lack of knowledge of related functions in projects activities is an issue. In order to work cross functional and efficient it is crucial to know the other functions work tasks, both their contents as well as their performances over time. According to Lean theory, work tasks provided in a project should be according to a systematic sequence of time, meaning when a task has been executed and are distributed to an internal customer it should be in accordance of the sequence. Documents and work tasks should never wait to be performed and in the quest of reaching that it is of utmost importance that all people acting in a project

have the same view of where the project is in time, plan, execution, and future performances.

*Visual Planning* is a tool proposed to be implemented at Volvo GTT in order to provide an organization where all involved roles in projects have a coherent view of the situation and will increase the employees understanding and awareness regarding the project performances of current and future state. They will be able to forecast the activities easier and plan their own work according the time plan. Each employee will be informed when other functions are performing tasks that they may be affected. They are then able to plan deliveries and/or receiving's more efficient. Different functions and roles are also able to support each other, by immediately identifying work that already has been performed, and in that way eliminate rework. Projects activities will be stated continuously which makes it possible to trace events, deliveries, delays or other significant tasks during a project. Management are able to evaluate the activities sequences to become even better and bottlenecks can easily be identified. If the root causes of the delay are found the project learns what to make different next time. Management will have the problem occurrence exemplified of a reality event and might hopefully regard its importance. With a Visual Planning board transparency of information can be achieved.

**Visual Planning board:**
- The different functions/roles in a project are regarded as a group and are together building the visual planning model into their project mode of operations. The roles are for example:
    - Project Manger
    - Systems Engineering
    - Product Planning
    - Feature Leader
    - Design Engineer
    - Test Engineer
    - Calculation Engineer
    - Etc.

In Appendix J, the procedure of the different steps is described and acts as the foundation of the performance. In Figure 44 the visual planning board is illustrated and exemplifies the procedure visually. Each row represents one person, and each colour of the sticky note corresponds to a specific action.

**Figure 44.** To the left: Visual planning board exemplified. To the right: Visualization of colours for different activities.

- Each activity that is to be performed is stated on the board by making a note on a sticky note with:
  - Short explanation of the activity.
- Defined deliveries are stated with a blue sticky note.
  - Write down what is to be delivered shortly.
- If any disturbance has occurred on the performed activities, such as delays, it is stated with a red sticky note.
  - Short information of the disturbance, and how long the delay will be. Replace the activity deliveries for that activity.
- If an activity cannot be performed because of waiting for information of someone else, this is stated on an orange sticky note and is placed on the planned activity on the board.
  - Name of the person/role that has not been delivering the information needed in order to perform the activity.
- If a person knows he/she will be off work for some days this is stated with a purple sticky note and placed on the first day to be out of office.
  - State the dates to be away.

The red cord on the board that can be visualized in Figure 44 shows the current day of the week. It should be updated each day by someone in the group, preferably the one located

closest to the visual planning board.  The main activity that is to be performed the next coming week is stated on the board as well as the next coming month. When the week has passed, the activities performed are erased and the delayed deliveries are replaced from the "previous week" column to the day they will be performed on the new current week.

This visual planning board is formed based on the planning of one project execution. The recommendation is to test this way of working on one group of people from different functions interacting in a project. The pilot project team will also have the possibilities to influence the visual planning board by suggesting refinements of the board layout and the procedure, in order to suit them and the organization better.  The pilot project group will be the foundation group that will act as the implementer when adopting the visual planning board on the other project groups in the organization. The visual planning board is perhaps not necessary to use in smaller projects in the future at Volvo GTT but its contributions could have major positive influence on larger projects due to that larger projects are more complex and also more difficult to control.

The Visual Planning board should be placed so it is close to as many of the participants' as possible. This is a moment of transportation of the people involved in the project group that might be considered as unnecessary movements. However, the procedure will bring back times and cost in the long run. It will also give the participant's the possibilities to interact with each other on a face to face level. They will get to learn each other better while larger project at Volvo GTT are running for several years. This interaction on a basis level is important for the work. The meetings should be considered by the project as an opportunity to take a cup of coffee and by enthusiasm find out what the other colleagues have for planned activities further on. It is also to support and encourage the others that states out that they have problems in their work. This methodology is applied by Ruag Space AB and can be read about in chapter 7.

### 10.7.2  Improvement Boards
A lot of knowledge is within people's head which contributes the condition to underline the importance of involving the employees in the work to become more quality oriented. The proposed solution is to implement an Improvement Board, which will act as a visual tool to provide to the organization and management to enhance continuously improvement method to the work. The aim is to provide a bottom up process, not a top down, in order to let the employees generate the ideas. The method is based on the PDCA cycle that is focused on to continuously improving the organization and to stay ahead of the competitors. It will also reveal the possibilities to be able to anchoring procedures of performing "Do it right the first time" establishment.

This is an approach that can be implemented in the entire organization at all levels and departments. However, the recommendation is to start gently, on one pilot group and not be eager to implement in several different groups directly.

The determination to recommend this approach to be implemented is also based on the large number of identified problems. Several problem related factors have been identified years ago and have been influencing projects for a long time. The aim for the future is to identify the problems immediately, preferable before they even occur. By this approach this

future goal can be executed. What must be emphasized is that the Improvement Board is not regarding product-technical function problems, it is aiming towards create better mode of operations to prevent product-technical function problems to happen.

The Improvement Board can according to literature be used in different group layouts, project group and function groups. The proposal is to implement the Improvement Board on Feature Leaders (10 in each group) as participants rather than on a project´s involved functions. In this way the Feature Leaders are able to state problems within their own role function group. It is important that the responsible for the Improvement Board meetings, the Lean Manager, is a volunteer to the assignment as the literature states.

The procedure of how to work with the Improvement Board is stated in Appendix J. The main steps are specified and illustrated. The Improvement Board can be viewed in Figure 45.

**Proposal:**
Important factors that must be considered are when adopting the Improvement Board methodology are:

1.  The information that is needed about the issue/idea identified are specified on the sticky note, see Figure 46.

2.  All ideas and issues are considered at the meeting, which implies the level of impact and magnitude are disregarded. Issues can be anything from meeting frequency to how a certain procedure is performed.

3.  When the issue and suggested proposal has been described by the issue owner, the group discuss and determines where it should be stated on the pick chart (Implement, Challenge, Kill, possible), see Figure 45.

4.  Depending on where it is placed, new actions are taken:

    a.  **Implement "Just Do It"**→   The issue has been determined by the group to be solved directly and with not much need for resources or authorities. The executor of solving the issue is appointed directly at the meeting and should in the nearest time solve the issue. The note is placed on the "Just Do It" square.

    b.  **Challenge** →   This issue has been determined by the group as an intractable issue that needs a battalion of resources (people, costs) but still provides great value to the organization. This kind of issues must be considered with caution and needs to be distributed to a higher level of authority and management in the organization. The stated note is placed on the "issue identified" square in waiting to be distributed to a specific person/function in order for further investigation. The Lean manager specifies the issue/idea in more detail on a specific sheet. The stated sticky note must be traceable towards that document and are noted with a number. After, when the correct function/manager has been appointed the mission to investigate the problem identified, the Lean Manager replace the sticky note from the "issue identified" to the "Other functions" square. In that way it is visible for everyone who is in charge for investigating the identified issue/idea

at the moment. The investigation must be documented by the middle management investigator and there must be a statement of the action of the problem identified. The employees must be informed if/how/when the solution takes place and the reason for that. Once a month an even higher level manager meet to go through the problems identified that are about to be investigated or that has not been solved by the middle manager. It shows that managers at all levels support this way of working and regard it as crucial for quality work and improvements. They are also able to follow statistics of the frequencies result of performed solved issues.

If there is no need to involve middle manager regarding the issue/idea solution in this stage, the "possible" procedure includes the same thinking.

   c.  **Kill** $\rightarrow$ The issue is identified by the group as not contributing to any value for the people in the group, the organization or other functions in the company and will provide high costs to solve. The group needs to decide weather to reject or solving the issue identified, or continue working to solve it. However, this issues are recommended to be rejected.

   d.  **Possible** $\rightarrow$ This kind of issue has been considered by the group that needs to be manage. Solving the problem will contribute with high benefits to the oragnization, group or individuals and will be of minor cost to achieve. Due to the magnitude of solving or taking care of the issue it is determined at the meeting who will be appointed to solve it. It could be someone within the group or another role within the organization at another department.

5. If it is stated that there is no need for involving middle managemeent in the work: The person in the group appointed to solve the issue or carry out the idea has the responsibility to fill in the Improvement Board concurrently. He/she must place the sticky note on the board, fill in where in the PDCA cycle (Plan, Do, study, Act, see chapter 6, for clarification of this term) the proceeding improvement work is at the moment. State the name of the responsible owner and when it is forecasted to be finished. If the group decides that this idea or issue identified should be performed/solved by another Feature Leader in another group, the Lean manager is appointed to distribute the information to that Feature Leader. The issue/idea note is put on the "other functions" square on the board. When the Feature Leader in the other group/function has confirmed to solve the issue or carry out the idea, the note is removed from the board and put on his/hers group Improvement Board and specifies all the information needed on that board.

6. The board should be permanent and always located at the same spot. Preferably, the board should cover a white board size with always complementary pencils and sticky notes.
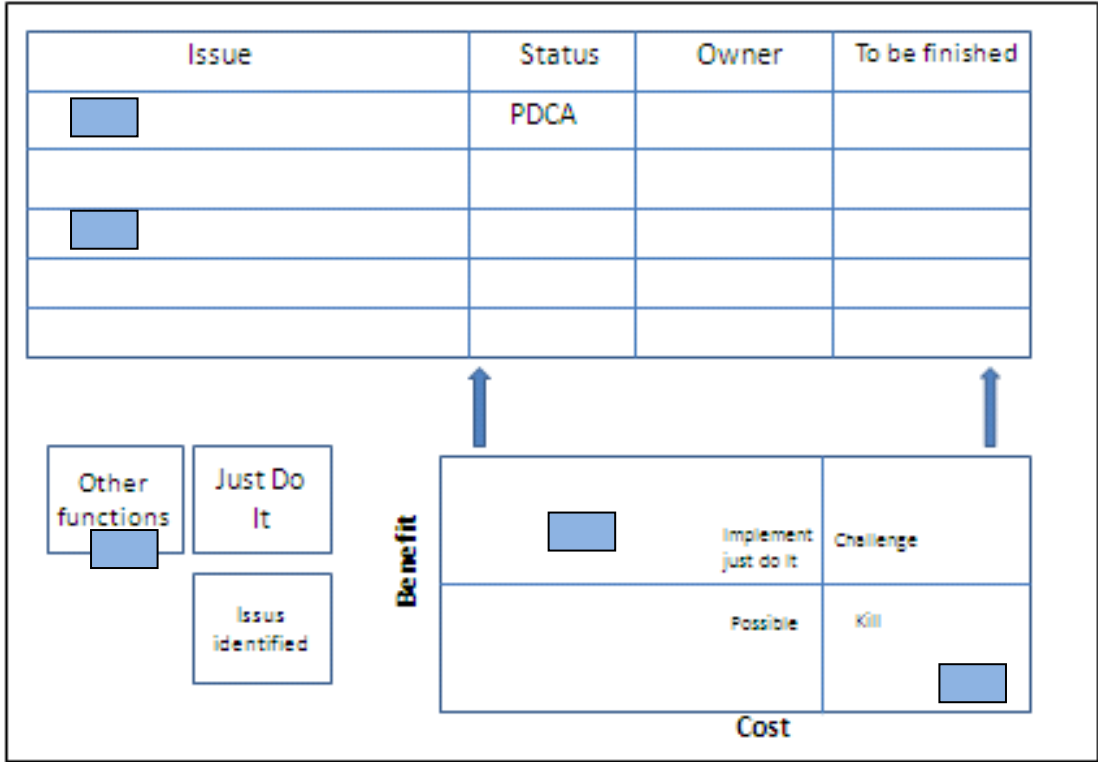
**Figure 45.** Improvement Board (often illustrated on a "white board").

| From: | To: |
|---|---|
| Idea generation/Issue statement: | |
| | |
| Approximated cost: | |

**Figure 46.** Sticky note that is placed on the Improvement Board.

**10.7.3  5S**

To become a Lean thinking organization one of the keystones are to have a high level degree of order. This regards the organization as a whole down to the lowest level in the company. The five words that represent the 5S thinking are: sort, standardize, set in order, shine, and sustain. 5S is part of the visual management methodology and creates the opportunity to keep control in the organization with the vision to keep order and that the every document, equipment, binder etc. has its unique place. The question of why this way of working is essential is easily answered by the fact that people that recognize modes, layouts and location of different documents might achieve smoother and effective work modes.

From the benchmarking result it turned out that Ericsson AB advocates the importance of the 5S implementation in the daily work in the organization. Standardized operation is a base for qualitative work at Ericsson Borås.

- The layouts of the desks in the company are standardized constructed.
- The computer is placed on the same spot on all desks.
- The keyboard is placed in front of the computer screen.
- The mouse is placed in front/beside the keyboard.
- No cables on the desks.
- When leaving the desk after a work day, documents should not be placed on the desk, the desk should be clean.
- An information panel located at the desk with standardized information that could be of use of others, e.g. Phone number, date of return.
- No overfull trash bins.

# 11 Discussion/Analysis

It has been discovered that there are areas that must be considered and evaluated further in order to refine, update and improve them incremental. Mainly, the problems identified are based upon the unclearness of processes, methods, operations descriptions and instructions. There is an unawareness of important information that is needed for quality focused work. The evaluation result indicates that many of the identified problems are based upon the company's philosophy towards a knowledge driven organization. It implies the amount of knowledge losses within the organization that could be used for quality related and improved extent in the daily work. What must be considered by the managers at Volvo GTT is the fact that employees are uninformed regarding sufficient procedures, decisions, and tasks. There is a lack of a coherent view among the employees regarding purposes and functions of different methodologies. It is a keystone in every organization to ensure that the employees have the same view and understanding of this factors otherwise people are aiming for different goals, which contribute to poor quality performance in the organization and the end product.

## 11.1 Process Principle of Lean Product Development at Volvo GTT

Theory expresses successful processes as standardized, waste free, and optimal in lead time perspective. Standardization is an effective way to work, in order to avoid establishment of new procedures each time a task is performed. Volvo GTT is effective in that way, they consider process standardization and documentation as an important part in the organization. What has been determined is that the critical processes are documented and well performed at Volvo GTT, but they are not used qualitative and frequently. The result in this study indicated that an amount of the employees are not aware of the sub-processes existence in the GDI:s, their location, or that they have difficulties in discern the document information. This advocates the need for Volvo GTT to perform an action plan of how to implement the processes into the employees mind in order to create process thinking among the employees.

The fact that employees of different roles in projects are setting their own processes within the project is a major factor that negatively affects the work. This provides a domino effect of disturbances and problems in the work flow and require rework and controls that are of unnecessary nature. Uncertainties of what tasks are to be performed and their sequences in a project will provide inefficient operations. People that feel insecure towards their work tasks can never perform optimal and will contribute the project with contingency of their mode of operations, which is not a qualitative way to work. However, in product development it is challenging to follow one process step by step without deviations and sometimes it might even be necessary to diverge. Generic processes are challenging to manage when a huge amount of large and small projects are running. What must be considered is to evaluate how much this deviation is acceptable to vary. Otherwise it might be forced out to be uncontrollable and people might digress beyond levels that are not tolerable of the process frame. Management must regard this issue as a crucial factor and ensure that the employees follow the processes' instructions and the foundation strategy in order to work in the same direction. This area could be severe to improve due to the fact that the product produced at Volvo GTT is very complex and requires complex project processes. However, the problem identified is that the employees cannot be ensured what

process to work along when starting in a project, since the process is adjusted for each new project. The standardized process must be enhanced or better communicated towards the employees at Volvo GTT.

Generally, a process is established in order to ensure that the people involved in a project, follow a sequence of tasks. This is a foundation to be able to provide a waste free project. If the process is optimal according the organizations values and goals, fluctuations can be controlled and reduced. "Do it right the first time" is a common express and a term many organizations are aiming at. A lot of time could be saved if everyone acting in a project performed their tasks correct with no need for clarification, discussions of purpose, misunderstandings, or other unnecessary motions. At Volvo GTT, when Feature Leaders are translating targets to requirements, a proportion of the Feature Leaders need to go back to the Product Planner to ensure the pre-requisites have been truly understood. This is critical since if the pre-requisites not have been perceived correctly, the project purpose might get huge defects. It is preferably significant as a Feature Leader to turn back to Product Planning to clarify the contents of the prerequisites. However, if this is an on-going issue, affecting many of the Feature Leaders work and Product Planning in perspective of efficiency, the prerequisites texture might be deliberated. Consequently, to provide a process and knowledge that ensures that everyone's comprehension of it is correct is highly prioritized. Even if there are always controls of pre-requisites and interactions between Feature Leader and Product Planning, time could be saved and this should be regarded. It has been discovered that Systems Engineering also has the need for a regular repeated discussion with Feature Leaders when requirements have been stated. Requirements need to be SMART which is a very important factor when establishing requirements. By increasing the understanding and comprehension of the SMART approach among the Feature Leaders, this area could be improved even more. However, the high level of communication and interaction is significant and critical between Feature Leaders and the project functions and must not be decreased. It is the communication that causes rework and throwbacks that must be decreased.

An interesting area that has been discovered based on the interviews performed, is the indication of prestige fulfilment rather than prioritization optimization of the product. This is a statement that implies the absence of a coherent view of the entire organization. If the product is not put in the middle with focus on the customers demand the competitors might end up ahead. When problems occurs in projects the question is not how to find the easiest way around the problem, it is rather a question of how to solve the identified problem in the best of ways for the end product. It is regardless who will be affected, who will be appointed, what function that have to set in additional resources, etc. All functions in a project should all regard the importance of providing the project the resources needed in order to fulfil the customers' demands, nevertheless have the same view of the goals and direction.

When Feature Leaders reporting status in projects they are using the colours of red, yellow and green which is an effective way of coding the status in a visual way. However, it has been indicated that when status is set to red, the questioning is comprised. There is low interest of how to solve the actual problems, it is rather more interesting of how to continue the work regardless the red colour, just in the quest of passing next gate and follow the

project plan. There are two views of this issue. Projects based on complex products are natural formed to become complex. That might affect the activity procedures that have difficulties to be able to follow the processes. This is the same for requirements fulfilment in some perspectives. At some points the project must look beyond the process instruction and deviate from it by use common sense. If a non-main driving requirement is not being fulfilled the process instruction is regarded as not necessary to be followed. This action should be more of a last resort than of a daily escape. Nevertheless, the codes are established in order to visualize the status of the project regardless of minor or major influences on the end product. The other interesting issue regarding this colour coding of the status report is the ignorance of the green status reported. This event could be exemplified with a technical control of the status of an airplane before taking off. Red colours in cockpit indicate technical problems and must be taken care of before passing any confirmations. The pilot looks rather twice on the dashboard to ensure there are only green colours and ensuring they actually are green and not yellow or red. This view should be the same as for projects at Volvo GTT, project should questioning if the status is green, ensuring it is truly green, in order to work in a proactive way and eradicate problems to occur later in the project. Red colours indicate a problem that must be regarded and solved and cannot be passed before they are transformed into green and fulfilling the requirements.

Design Engineering and Feature Leaders have an intense and crucial interaction along projects at Volvo GTT. This communication is critical in order to provide optimal products. Today, there is a poor understanding between the both functions functionalities and what their areas of responsibilities are. The Feature Leaders considers sometimes that they need to act as policemen's ensuring that the Design Engineers are performing the tasks they are intended to. The Design Engineers are the technical establisher and provides solutions that are fulfilling the requirements. It was discovered that Design Engineers at some points are stating their own requirements regardless the Feature Leaders input, which might contribute to severe situations in projects. Consequently, the interaction between those two functions is critical due to the fact that if the technical solutions do not correspond to the requirements the project is carrying out a risk of the end product not being provided.

## 11.2 People principles of Lean Product Development at Volvo GTT

The literature study campaigns the importance of establishing processes around the employees in the organization in order to provide successful results. This indicates the people working in a company are valuable sources in order to become successful and achieving improvements. The people system at Volvo GTT with focus on the Feature Leaders role comprises several areas where Lean thinking and improvements must be adjusted. In order to be coherent to the Lean way of thinking in projects among the employees and managers, the people principles should be analysed.

The responsibility distribution of different actions is regarded as unclear when working in projects and the employees are unaware of the ownership of different procedures. The information regarding ownership can be found in the process descriptions but it is unclear who owns the different tasks performances within the different main processes. Feature Leaders do not use the documents available to the extent required. Causes can be based on the large amount of text in the documents and therefore people dismiss the documentation

based on overload of information. Areas of causes can also be based of the unclear information distribution of where to search and find significant information, could also be based upon managers' assumptions that the Feature Leaders are aware about information locations in Team Place and its contents.

The knowledge of the activities performed in projects is lacking since the employees do not have the full view of what actions are expected. This is the link towards the poor way of working with continuous improvements. There is no official procedure of how to handle identified problems or how to work in a proactive way. Once a month the Feature Leaders meet (participating is voluntary) at an official forum called FLGOT (Feature Leader network Gothenburg). It is a significant forum for the Feature Leaders to meet and discuss subjects. However, the purpose and need for a forum where the Feature Leader can be engaged and state problems they consider important and provide proposals and solution are crucial. A lot of information and knowledge is within the mind of the employees and are therefore often the source for improvements. Their considerations must be systematic taken care of, evaluated and provided. At Volvo GTT this kind of forum is important for the continuous development in the quest for high level of quality throughout the organization.

Volvo GTT is a global organization which implies the culture differences appearance in the operations and of the individuals' behaviour. It has been obvious that employees have difficulties to express themselves when communicating with other functions on the other side of the globe. Such events are regarded as poor quality performance, when people interacting with each other within the organization, having difficulties understanding one another. The language difficulties have not only been identified to occur between countries, it has also been showed to occur domestic at Volvo GTT. Misunderstandings are often a factor that emphasizes rework which are associated with waste and are according to Lean something that must be reduced. There are a lot of corporation between Gothenburg and the other sites and it is highly important that the functions interacting with each other from different cultural backgrounds and organizations have the same view of the processes. What must be considered at Volvo GTT is that everyone is unique and everyone has their own needs and different thoughts of what is important. It will be severe for an organization to succeed if there is no bottom up sharing and believing in the entire company's value and their way of working. This must be considered even more since Volvo GTT has joined other companies.

When new employees start as a Feature Leader at Volvo GTT there is a lack in the procedure of their introduction toward their work tasks. This is according to the people principle as a significant area to not disregard as a manager. There is a training material available for the Feature Leaders that could act as a foundation document to support the employees when starting to work as Feature Leaders. However, it is a document that is unfamiliar to many Feature Leaders and where it is located. Basically, at Volvo GTT there is a lot of document provided for the employees that can support their work tasks and knowledge development. The problem is often founded by the fact that employees do not know about significant documents existence and hence both information and time is wasted.

Followed by the previous paragraph Lean thinking regards the long term perspective as crucial thinking considering employees career path. To provide a knowledge based

organization it is significant that the employees are loyal towards the company. Therefore is it important to establish long term plans for the employees. The employees must be regarded as a part of the future in order to connect to the organization.

Another important area is to offer the employees continuously training and education in their area of expertise. At Volvo GTT there are not enough resources to support training and professional development of the employees. Sometimes though, Advanced Engineering (AE) projects (Research and Development) are performed which gives the possibility for the employees to learn and develop their knowledge.

## 11.3 Tools and Technology Principles of Lean Product Development at Volvo GTT

According to literature, tools and technologies should be added into the organizations when existing processes and working methods are optimal and ensured. This is a critical factor in order to succeed and become efficient. The literature also points out the importance of having standardized documents and ways of working. Volvo GTT has a correct view of the importance according working in a standardized way. Their global development plan, global instructions and standardized processes are examples of that. However, the there is a lack of actually following those standardized processes. Among others, it was found that when distributing requirements on different levels from Feature Leaders to Systems Engineering it has been discovered that different formats and ways are used for presentations. Different ways are performed at different sites and roles which imply that System Engineering gets different formats of documents. When information is transported frequently between different functions it is advantageously to use same formats to fill in documents. It will provide a better and efficient receiving and sorting procedure.

Today at Volvo GTT there is a structured way of breaking down targets to technical customer requirements by different steps. The procedure is well set and provides information about affecting modules on the different features. Their way of working is linked to the Lean thinking of the tool Policy Deployment.

Information regarding the project status is stated in PowerPoint sheets and is visually illustrated. When status reporting, literature suggests including information as: proposals, problem solving, and status reporting and competitive analysis. These different factors are stated at different stages in projects at Volvo GTT. However, the Competitive Set in the status report is not considered important. The information is never discussed at status reporting meetings according to a proportion of the Feature Leaders. It has been identified that only the critical feature of projects are prioritized to perform competitor analysis. That brings the fact that an amount of feature status reports includes competitive set that is several years old. They are considered as not corresponding to the current situation of the competitors and bring the difficulties to forecast the competitors' development.

The awareness of the competitors' location on the market is critical in order to stay in the lead. Developing and refining products demands the awareness of the competitors' position. Projects at Volvo GTT are often run for several years, which also imply competitors' development will be changed over the years. It is stated in the status template to set the

"forecast competitive set", meaning stating where the competitors will be when the certain project at Volvo GTT is finished. This instruction is according to Lean thinking. However, if the current situation stated is in fact several years old how can one ever forecast the competitors' status in several years ahead. While it has been discovered that the instruction is not followed, it is important to evaluate the need for competitor set and to analyse the importance of invest in competitor analysis. It is a challenging and cost related area but nevertheless an advantage operation in a long term perspective. Consequently, when status reporting in projects it has been determined that Feature Leaders states the current situation status as red while they state the forecasted status at SP-start to green. This is not according to Lean methodology and misleads the project with information that is not of judging quality. However, this view is according to the process of how to set the traffic light in projects at Volvo GTT, but it has been indicated not to be followed entirely.

# 12 Recommendations

Based on the result and analysis part, this section will mediate recommendations for improvements and Lean thinking accomplishment in the organization of Volvo GTT, with focus on the Feature Leaders work in projects. The different areas that will be stated are regarded as new ways of working in order to become more Lean oriented and quality ensured. The Value Stream Mapping and the interviews performed are the base for the determination of the current situation of the Feature Leaders and related functions work tasks in projects. The current way of working and the current position of the employees' perspective of awareness regarding different tasks, processes and roles need a transformation in order to increase the level of awareness and quality control.

It could sound needlessly and time consuming to start up a programme to implement a regular condition of arrangement throughout the organization of Lean thinking. However, it is necessary in order to provide an organized and qualitative way of working. Based on the findings from the results in this project referring to the literature study, a final recommendation is presented in this chapter. It describes what Volvo GTT with focus on Feature Leaders operations needs to enhance with quality in focus at all levels. The benchmarking (chapter 7) also acts as a recommendation part of proposed solutions.

**Processes**

It is important to ensure that the employees follow the Global Development Instructions and the established processes. Do not let people have visions of walking their own path. People working together must be conformed to a coherent whole. The information should be clearly accessible. Ensuring the employees has understood the information in the documents. Evaluate and inform acceptable level of deviations of the global development plan. Establish the processes around the people working and make sure they are correctly understood and applicable. The importance of following the already established processes at Volvo GTT has been pointed out already. In order to be able to measure quality in an organization, the employees must work according to the standardized processes. Provide the Feature Leaders with the updated Feature development flowchart in order to make sure the established processes are followed. Furthermore, provide the Feature Leaders with the Feature Leader Role flowchart which will support the Feature Leaders..

Continuously map modes of operations in the project processes. It is the current status that is significant to be identified in order to improve.

**Lean thinking**

At first, Lean way of working can never be adopted if it is not supported from the top management. This is a crucial part to consider when changing ways of working with new directives to follow. People will never adopt changes if they are not regarded significant from the managers at all levels.

Develop a programme of the implementation of the new methods and tools and explain the process. Start with small steps and do not rush through the implementation procedure

regardless the degree of the method or tools to be implemented. Lean thinking should be considered as a system and a way to live that is important to keep in mind.

An important part when turning an organization into Lean thinking and methods is according from findings of the benchmarking study, the establishment of values and principles. That is the initial step for the establishment of Lean thinking. Those factors will act as the purpose for using different Lean tools. For Volvo GTT this is a crucial area to consider when starting implementing Lean operations. The organization must have a settled and secured foundation of the Lean philosophy, the keystones of what Volvo GTT consider as critical are set as a foundation. In that way the organization can always go back and look at those keystones to be reminded of the Lean philosophy at Volvo GTT.

**Use a structured process of continuously improvements:** Establish a model which will act as a method to secure the quality of working operations within the organization. Customize a method that will mirror the organization's view and values and how to provide an efficient model that will ensure to always striving to become better and reduce and eliminate waste. *Improvement board* has been described in chapter 10.7.2 and is a strongly recommended to adapt.

**Use Lean Methods and tools:** There are several methods and tools within Lean that will provide more efficient mode of operations. The methods and tools being regarded as important to implement are: 5S, Visual management, A3 management, Process Mapping, Visual thinking, and the PDCA cycle.

In order to provide and secure the implementation and continuous work of Lean in the organization the Lean scorecards should be used. This methodology and working procedure is not only recommended in literature study it is also used at Ericsson Borås (see chapter 6 and 7). This methodology will contribute to that the employees will consider their efforts and work to become a Lean organization more important. This is also a way for the organization to control their level of achievement of the Lean programme. Managers' involvement is critical and their view of the Lean implementation and work must be underlined of its importance at all levels.

**Use methods that enhance Information exchange:** An efficient way of creating new knowledge is the distribution of information between people. Every person has always significant information that could be valuable for others. Provide this opportunity to the employees and Feature Leaders. Perform smaller group discussions and/or internal benchmarking sessions in order to exchange valuable information. Sometimes the knowledge is closer than one might expect. The *Visual planning* board in chapter 10.7.1 is recommended to implement.

**Use learning as knowledge distribution:** When new updated information has been provided it should be distributed to be available around the organizations functions. It should be a database containing information of all different levels of relevance. By having a smart search engine in comparison with Wikipedia (search engine available on internet) where employees at Volvo GTT will be able to put information as well as search for information. This is an efficient and time saving way of distributing information and keeps up new knowledge.

**Use Communications plans:** Based on the interviews and survey results that indicated the quest of increasing qualitative communication, campaigns the recommendation of establishing communication plans in projects performances (described in the theory part). It will describe what communication is needed between different roles/functions in projects. It will exemplify what are the outcomes of the communication and will in that way ensure that the communication is sufficient and qualitative. Tracing poor communication can be done much easier and employees interacting in a project will have a clearer view of the network communication procedure.

**Use the advantageous of the outcome of the White Book:** Lesson Learned is a favourable knowledge driven method that will provide projects with information to prevent mistakes or failures in the future. Today, the White Book is used in projects but it was found that it was not used sufficiently. The application of the White Book needs to be updated and fully respected among the employees and managers. Conform it, reuse it, and anchor it into the organizations way of working.

**Use information gathered from other companies:** There is no better way to learn new things than listen to others with practical examples from the reality. This statement is quoted from Mr Boban Ivanovski, who is a Process Manager within Improvement Management at Ericsson AB. Evaluate the Benchmarking provided in this report to analyse the outcome of what are the most significant to compile as a first step. The benchmarking report in chapter 7 acts as a recommendation for Volvo GTT to view and consider.

## 12.1 Striving for perfection

Volvo GTT is the world's largest manufacturer of heavy trucks and market leaders within passive and active safety. This fact implies the prosperous health the organization indicates which pointing at the factors of being very prominent and successful. The major aspect to consider when being located at this position on the market is to never be completely satisfied. Meaning the race is never completed. It is a constant competition of providing the customers the best product and possesses the largest market share. It is no doubt that Volvo GTT bears the technology needed, the competence and the history of a long and successful story. However, what is important to consider is the awareness of competitors' advancement in the quest of replacing Volvo GTT as the number one position on the market.

To stay in the lead this project report has been describing the needs to never be completely satisfied of the current situation. The quest of searching for roads that will lead to other dimensions to secure quality throughout an organization is one main concept based on a new way of thinking - The Lean Thinking. Striving for perfection at all levels in the organizations is manageable if the determination of wanting to stay in the lead is stated. The Lean way of working is becoming more and more established in organizations around the world. It is only a question of time until the Lean system is a natural foundation in companies. Therefore is adapting the model of Lean of major importance in order to secure quality as a core substance throughout the entire organization of Volvo GTT.

# 13 Conclusion

This report represents the fulfilment of the objective in this thesis. The contents will act as a first step for Volvo GTT to start working in a more  quality related environment in the Feature Leaders work. The report presents the current situation of the Feature Leaders work in projects and acts as a foundation for Volvo GTT to improve their work in those areas described in the result chapter in this report. Areas that has been regarded as non-value adding activities has been identified, which gives Volvo GTT the opportunity to strengthen their operations in those specific areas. It has been specified in this report the conflicts and contradictions with the related processes SE, PPL, and CV3P which are important factors for the company to consider, while the interaction between the Feature Leader and those processes are critical and a main part in projects. Based upon the findings and the result part Volvo GTT will hereafter act in the direction they believe is critical. However, this Master Thesis has given them a good start and provided proposals in which area to start their improvement work. Hereafter is it Volvo GTT who will evaluate the report contents and realize their situation in today's projects and the problem areas identified.

# 14 References

**Articles & Books:**

Bergman, B. & Klefsjö, B. 2010. Quality from Customer Needs to Customer Satisfaction. Studentlitteratur, Lund.

Coffman, J. 2004. Strategic Communication audits. Communication Consortium Media Center, Washington DC

Ejlertsson, G. 2005. Enkäten I praktiken. Studentlitteratur, Lund

Fouquet, J.B. & Gremyr, I. 2007. Design for Six Sigma and Lean Product Development-Differences, Similarities and Links. Chalmers University, Gothenburg, Sweden

Holmdahl, L. 2010. Lean product Development På Svenska. Stromia Digitaltryck AB, Gothenburg, Sweden.

Harry, M. J., Mann, P.S, Hodgins, O.C. De., Hulbert, R.L. & Lacke, C.J. 2012. Practitioner's guide for statistics and Lean six sigma for process improvements. John Wiley & Sons, Inc. Hoboken, New Jersey.

Jacka, J.M & Keller, P.J. 2002. Business Process Mapping IMPROVING Customer Satisfaction. John Wiley & Sons, Inc., USA, New York.

Kvale, S. 1996. Interviews: an introduction to qualitative research interviewing. Sage Publications Inc., California.

Letens, G., Farris J. & Aken E.V. 2008. Lean Principles for the Lean Project-Based Enterprise. Proceedings of the 2008 Industrial Engineering Research Conference

Liker, J.K & Morgan J.M. 2006. The Toyota Way in Services: The Case of Lean Product Development. Academy of Management Perspective, Michigan

Liff, S. & Posley, P.A. 2004. Seeing is believing: how the new art of visual management can boost performance throughout your organization. AMACOM, New York.

Mascitelli, R. 2011. Mastering Lean product development: A Practical, Event-Driven Process for Maximizing Speed, Profits, and Quality. Technology Perspectives Inc., Northrich CA

Maskell, B. H. & Baggely, B. L. 2006. Lean Accounting: What´s It All About. In the Association for manufacturing excellence target Magazines.

Maylor, H. 2010. Project Management. Pearson Education Limited 1996, 2010.

McManus, H. L. 2005. Product Development Value Stream Mapping (PDVSM) Manual 1.0. Metis Design 222 Third St., Cambridge MA

Power, K. 2012. Identifying and managing waste in complex product development Environments. www.slideshare.net

Richmond, McCroskey, & McCroskey, 2005. Organizational communication for survival: Making work, work. University of Alabama, Birmingham

Sandholm, L. 2000. Total Quality Management. Studentlitteratur, Lund.

Summers, D. C.S. 2011. Lean Six Sigma - Process improvement tools and techniques. Pearson Prentice Hall, Boston.

Ulrich, K.T. & Eppinger, S.D. 2008. Product Design and Product Development. McGraw Hill, New York.

Ward, A. C. prologue by Shook, J. & Sobek D. 2007. Lean Product and Process Development. The Lean Enterprise Institute Inc., USA.

Womack, P. & Jones, D.T. 2003. Lean Thinking –Banish waste and create wealth in your corporation. Free Press a division of Simon and Schuster Inc., NY USA.

**Electronic sources:**
Andersson, J. 2004. 5S i Korthet. [Electronic]. Available at: http://rolflovgren.se/RL-MDH/5Ssammanf.pdf [3 April 2012].

Collegiate Project Service. 2007. Developing your project communication plan. [Electronic]. Available at: www.collegiateproject.com [2 May 2012].

Knutsson, S. 2008. Analys och tolkning av kvalitativ data. [Electronic]. Available at: http://people.su.se/~sknut/e_analysochtolkning.pdf [5 April 2012].

Red Lion Controls. 2011. Visual Management – increase your company's profitability through insight. [Electronic]. Available at: http://www.redlion.net/Support/VirtualHelpDesk/WhitePapers/PTVWhitePaper.pdf [4 April 2012].

Sayre, R. 2009. Visual Management for Agile Teams Posted. [Electronic]. Available at: http://characterandexcellence.wordpress.com/2009/02/19/visual-management-for-agile-teams/ [4 April 2012].

University of Sheffield, 2012. LeTS Evaluation Resources. [Electronic]. Available at: http://www.shef.ac.uk/lets/evaluate/general/methods-collection/interviews [4 May 2012].

Öjmertz, B. 2004. Aspekter på ledarskap. [Electronic]. Available at: http://extra.ivf.se/lean/pdf/ledarskap/Lean%20ledarskap-20n%C3%A5gra%20viktiga%20aspekter.pdf [14 May 2012].

**Interviews:**

Mr Attila Fükila, Project Manager, Lean Specialist. Volvo Car Corporation. [19 March 2012].

Mr Boban Ivanovski, M.Sc. Process Manager Improvement Management. Ericsson AB. [23 March 2012].

Ms Hanna Ljungqvist, Business Consultants within Volvo Group Trucks Technology. [4 April 2012].

Mr Durward K. Sobek II, Ph.D., Professor and Program Coordinator of Industrial Engineering, Montana State University, Bozeman, Montana, USA [3 February 2012].

Mr Per Malmborg, Operations Development and Lean Manager.  Ruag Space AB. [21 March 2012].

**Internal documents at Volvo GTT:**

Feature Leader Survey, 2011, performed by: Mr Makula, Pierre-Alain-Chief Engineer Driver. Productivity and Mr B. Berle, Anders-Manager of Fuel Efficiency & Deputy Vehicle. Productivity. Volvo Group Trucks Technology, [Spring 2012].

Global Development instructions:

-Common Complete Vehicles Deliveries per Gate 960-46.

-Complete Vehicle Verification & Validation Plan 968-21.

-GDP Pocket guide.

-Feature Development process in projects 960-13.

-Feature Leader Training Material.

-Feature status template.

-Project Delivery Plan 960-48.

-Systems Engineering 960-07.

Global Development Plan.

Violin intranet at Volvo Group Trucks Technology, [Spring 2012].

Team Place intranet at Volvo Group Trucks Technology, [Spring 2012].

# Appendix A: Possible risks in the Master Thesis

| | |
|---|---|
| Low need of an action plan | <span style="color:green">■</span> |
| Medium need of an action plan | <span style="color:yellow">■</span> |
| High need of an action plan | <span style="color:red">■</span> |

| Likelihood | Consequences | | | | |
|---|---|---|---|---|---|
| | Insignificant | Minor | Moderate | Major | Severe |
| Almost Certain | | | All people will not answer on the survey | | |
| Likely | | | | The Master Thesis team will not get hold of important persons to interview | |
| | | | | The Master Thesis team will not get hold of important companies to benchmark | |
| | Supervisors require extra presentations | | Supervisors is not agreed with the proceeding work | People do not consider the interviews/workshops important | People do not understand the purpose of the Workshop |
| | | | All respondents will not answer all questions in | The scope of the Master Thesis work is changed | People do not show up at Interviews/Work- |

| | | | | | |
|---|---|---|---|---|---|
| | | | the survey | during the project | shops |
| Possible | | | | | Files with data and information is lost due to computer problems |
| Unlikely | | | | The Master Thesis work will not deliver the result on planned time | The supervisors are not agreed with the result |
| | | | | The Master Thesis work team is not agreed with the planned work and result | The Master Thesis work team lose the aim of the Master Thesis during the work |
| Rare | | | The supervisors are not engaged in the work | | Master Thesis work members will be unavailable to work with the project |

# Appendix B: Accordingly action plans to the identified risks

| Risk identified: | Functions affected: | Quantification: | Forecast actions: | Actions when occurring: | Responsible: |
|---|---|---|---|---|---|
| -All people will not answer on survey | -The Master Thesis team | Moderate | Emphasize the importance of the peoples considerations regarding the questions in the survey | Send out reminders to those that have not answered the survey. | The Master Thesis team |
| -The Master Thesis team will not get hold of important persons to interview | - The Master Thesis team | Major | Emphasize the importance that people participate and of their contribution to the master thesis work and how they have possibility to affect their own situation by participating | Contact people several times and explain the purpose of the interview and importance of their contribution. Find other people with corresponding knowledge that will work as stand-in for those that will not participate | -The Master Thesis team |
| -The Master Thesis team will not get hold of important companies to benchmark | - The Master Thesis team | Major | Be humble and pragmatic regarding time for the interview. Contact many companies in order to increase the probability to get hold of companies | Try several times to get hold of the companies that are interesting to benchmark. Contact other companies if it is not possible to get hold of certain companies | - The Master Thesis team |
| -Supervisors require extra presentations | -The Master Thesis team  -Supervisors | Insignificant | Agree in the beginning of the master thesis work about what will activities that will | Presentations that are required of course needs to be performed and hence to prepare | -The Master Thesis team |

| | | | be presented and when | them will be the most urgent activity when they are required | |
|---|---|---|---|---|---|
| Supervisors are not agreed with the proceeding work | -The Master Thesis team<br><br>-Supervisors | Moderate | Arrange meetings with all supervisors in order to discuss the aim of the project to ensure that everyone are on board | Arrange meetings and discuss what the different stakeholders expect from the Master Thesis work and why they are not satisfied in order to make everyone agree upon what is to be done | -The Master Thesis team |
| -People do not consider the interviews/workshops to be important | -The Master Thesis team | Major | Make sure in the invitations the importance of the participants considerations for the Master Thesis result | If the participants ignore their importance to contribute explain to them even more in detail what their participation will contribute with and what they will gain by participate | -The Master Thesis team |
| -People do not understand the purpose of the Workshop | -The Master Thesis team | Severe | Ensure that the participants has been informed about the purpose of the Workshop and their contribution in forehand | Time out of the Workshop and try to go back and explain the aim of the project by giving examples and show pictures of others performing the Workshop. | -The Master Thesis team |
| -All respondents will not answer all questions in the survey | - The Master Thesis team | Moderate | Make the questions as clear as possible so that they are easy to understand. Include only questions that are | Consider the response rate on the questions in the analysis of the survey to get a reliable result | |

| | | | considered to be possible for everyone to answer. | | |
|---|---|---|---|---|---|
| -The scope of the project is changed during the project | -The Master Thesis team<br><br>-Supervisors | Severe | Make it clear to the supervisors from the beginning what the team will deliver | Go back to what was said in the beginning of the Master Thesis work and make sure the original scope is fulfilled, and/or agree upon a new scope of the Master Thesis work | -The Master Thesis team |
| -People do not show up at Interviews/Workshops | -The Master Thesis team | Severe | Clarify in the invitation the importance of the interview/Workshop and the participants contribution to the end result and preferably get them to decline in advance | Try to call the participants or in another way get in contact with the participants | -The Master Thesis team |
| -Files with data and information is lost due to computer problems | -The Master Thesis team | Severe | Save back-ups with the gathered data and the written parts | Look over the time schedule and see ensure that there will be enough time to retrieve the information. If it is not possible the end date for the project has to be postponed | -The Master Thesis team |
| -The Master Thesis team will not deliver the result on planned time | -The Project<br><br>-Supervisors | Major | Make a detailed time plan and an activity plan in the early stage of the work and consider the time needed for all activities | Consider what activities that are most needed to be performed and see if they can be fitted in the time frame. Evaluate why the time frame could | -The Master Thesis team |

| | | | carefully | not be followed | |
|---|---|---|---|---|---|
| -The supervisors are not agreed with the result | -The Master Thesis team<br><br>-Supervisors | Severe | Arrange meetings with all supervisors in order to discuss the aim of the project to ensure that everyone are on board about what the Master Thesis will result in | Arrange a meeting and discuss what the different stakeholders expected from the Master Thesis work and why they are not satisfied with the result in order to agree upon what needs to be done to achieve a result that everyone agrees upon and that mirrors the aim of the Master Thesis | -The Master Thesis team<br><br>-Supervisors |
| - The Master Thesis team is not agreed with the planned work and result | -The Master Thesis team | Major | The team members shall be agreed on what they will deliver in the beginning in the project. Have continuously discussions about the work and the desired results | Discuss the different viewpoints of the work and the result until the team is agreed upon the work and what it will deliver | -The Master Thesis team |
| -The Master Thesis team lose the aim of the project during the work | -The Project | Severe | State the aim in the early phase of the work and make sure to go back to the aim continuously during the project | Go back to the aim and see what activities that has to be performed in order to fulfil the aim of the Master Thesis. If it is not possible, consolidate with supervisors and agree upon a change in the aim | -The Master Thesis team |
| - Supervisors are not engaged in the | -The Project | Moderate | Arrange meetings with the supervisors in | Try to involve the supervisors in the how the work is | -The Master Thesis team |

| work | -Supervisors | | order to make them engaged in the Master Thesis work. The activities that are to be performed during the work shall be well planned in order for the team to make own decisions during the work | proceeding by arranging meetings. | |
| --- | --- | --- | --- | --- | --- |
| -The Master Thesis members will be unavailable to work with the project | - The Project | Severe | Make sure in the beginning of the Master Thesis that the team members have the same view and goal with the Master Thesis work and agree upon how the work will be shared in the team. Agree in the team about how much time that will be spent on working with the Master Thesis | Establish a new time plan based upon when the team members will be able to work with the Master Thesis. | -The Master Thesis team |
| | | | | | |

**Critical:** Will cause total failure of one or more parts of the project

**Major:** Will increase costs in one or more areas

**Minor:** Will affect the project negatively but will not provide higher costs or delay the project as a whole.

(Maylor, Project Management, 2010).

The happenings that risk occurring are also explained more in detail here:

1. *All people will not answer on the survey*
   It is planned to send out a survey to all Feature Leaders on all the sites: Gothenburg, Lyon, Ageo, and Greensboro. It is always a risk that not everyone receives a survey will respond it. This is why this risk is placed on the Almost certain row. It will of course affect the result from the survey if not everyone answer it, but according to the theory one can only count with a response rate on 40-60% on surveys. Hence there won't be any major consequences, but the response rate may affect the result, the risk is placed in the Moderate column.

2. *The Master Thesis team will not get hold of important persons to interview*
   The keystone for gathering data in the Master Thesis work is to interview Feature Leaders and people working in functions interacting with them. Hence it will be a major consequence if people cannot participate in interviews. It is rather likely that some of the persons that the project team is interested to interview won't have the possibility to participate.

3. *The Master Thesis team will not get hold of important companies to benchmark*
   It is can be assumed that companies the Master Thesis team want to benchmark will not have the possibility to participate in benchmarking interviews. Since it is of great importance for this project to get inputs from other companies about how to implement Lean it is considered to be a major consequence if the team cannot get hold of companies of interests.

4. *Supervisors require extra presentations*
   Even though it is agreed in the beginning of the Master Thesis work when presentations will be held it is possible that the supervisors want extra presentations regarding how the work is proceeding or wanting more in the content of a presentation than the team thought. However, it will only have insignificant impact on the work. It will certainly take some extra time to prepare extra presentations but the time schedule for the Master Thesis work will allow for smaller changes in the time plan.

5. *Supervisors is not agreed with the proceeding work*
   It is possible that the supervisors at Volvo GTT and Chalmers will not be agreed upon the proceeding work and that is not good for the Master Thesis team since it will result in that all stakeholders is not agreed upon the outcome of the work. However discussion regarding the work in order for all stakeholders to agree on a desired outcome will probably be enough as an action plan for solving this issue. Hence the risk is considered to be of moderate consequence to the team.

6. *People do not consider the interviews/workshops important*
   It is considered as a major risk if people will not prioritize to participate in interviews and workshops due to that they do not consider the activities as important for their work.

7. *People do not understand the purpose of the Workshop*
   It is possible that people will not understand the purpose of the workshops they are requested to attend to. This is considered as a severe consequence since it will

increase the possibility that people do not want to participate in the workshops. Since the workshops are of high significance to the Master Thesis work and will impact the plan to succeed with the Value Stream Mapping of the Feature Development Process and their activities.

8. *All respondents will not answer all questions in the survey*
Even if the team strive to formulate the questions to be understandable for everyone it is possible, based on different reasons, the difficulties to ensure the participants to perceive the questions identically. This is considered to be of moderate consequence to the Master Thesis work. It will affect the result from the survey and it has to be taken into account in the analysis and evaluation of the survey.

9. *The scope of the project is changed during the project*
It is possible that the scope of the Master Thesis will be changed during the work and it is considered to have major consequences for the team. This is due to that the team will have to reconsider the planned activities in order to fulfil the new scope.

10. *People do not show up at Interviews/Workshops*
It is possible that people will not show up or be late at scheduled interviews or workshops. This is considered to have severe consequences on the outcome of the Master Thesis since interviews and workshops are the main activities for gathering data in this work.

11. *Files with data and information is lost due to computer problems*
It is possible that files are saved at wrong places and not found again, or that the team members forget to save while working, or that the files are lost for some other reason and hence information that is important to the project will be lost. This would be of severe consequences for the Master Thesis work since the team will have to retrieve the lost information which can be a very time consuming procedure.

12. *The Master Thesis team will not deliver the result on planned time*
If the Master Thesis team will not be able to deliver the result in time it will be of major consequence to the team members since it is not possible to present the work and hence get examined at Chalmers between the 15th of June and the 3rd of September 2012.

13. *Supervisors are not agreed with the result*
It is unlikely but if it happens it is of severe consequences to the team since it increases the risk for the Master Thesis to not get approved.

14. *The Master Thesis team is not agreed with the planned work and result*
It is unlikely to happen since the team members have been careful to be agreed upon the deliveries of the Master Thesis. But if it happens it is considered to have major consequences for the project since it will result in that the team members argue about the work instead of proceeding in the work. If the team members are not agreed it can result in tensions in the team which in turn can result in decreased quality of the work.

15. *The Master Thesis team lose the aim of the Master Thesis during the work*
This is considered to be of severe consequence because it will result in that the team is not working accordingly to the purpose and hence the end result will not be the desired result. It is though unlikely to happen since the team will be careful to follow the aim and crosscheck that it is followed during the work.

16. *The supervisors are not engaged in the work*

The supervisors at Volvo GTT as well as at Chalmers seem to be committed to supervise the Master Thesis work and hence it is considered as rare that this risk will occur. If it would be the fact anyway it will be of moderate consequence for the Master Thesis team. This is due to that it is of great importance that the team get supervision and support both from Volvo GTT and the university, but the team will be able to perform the Master Thesis work even if they are not getting the desired support.

17. *Master Thesis work members will be unavailable to work with the project*
It is considered as very rare to happen but it is always a risk that one of the team members will get sick or will by some other reason not be able to work with the project. If it happens it will have severe consequences for the work and it is a major risk that it will be delayed.

# Appendix C: Survey Questions and Answers

| Site<br><br>Question | GOT |
|---|---|
| **Q1/**<br><br>To what extent do you understand the Pre-requisites from Product Planning (PPL)? | • Feature part is easy to understand as we develop it together with Product Planning<br>• There is a risk that things are missed and not taken into account as they should<br>• Pre requisites are often written on high level and sometimes needs to be more specific explained<br>• Certain features information are spread out in the Pre requisites document<br>• The pre requisites are shifting quality<br>• Important input for the feature work can be found both in the feature part and in the "hardware part" per commodity<br>• If we then ask more specifically what that would mean, the question bounces only back to us again |
| **Q2/**<br><br>To what extent do you have to contact PPL again after you have received the Pre-requisites to ensure the Pre-requisites have been fully understood from | • Direct communication with PPL is a foundation for quality insurance<br>• The Feature Leader supports PPL<br>• Good to go back to ensure everything is clear<br>• Friday level is often easy to understand, otherwise a dialog is required<br>• More a dialog with colleagues in that perspective |

| | |
|---|---|
| your point of view? | |
| **Q3/**<br><br>Referring to the Feature survey 2011 the average answer of how good the communication between FL and PPL was 3,02 of a scale of 1- 5. How important is the communication between FL and PPL important for your work? | • Important while Design Engineers sometimes go directly to PPL instead of to the Feature Leader<br>• Poor communication in this area implicate a risk due to that different inputs are stated<br>• Very important<br>• The Feature Leaders work cannot be quality secured if the communication is poor, which its often is<br>• The communication is important in order to establish the same level of understanding<br>• Contact has been low in my feature area also due to PPL has been missing for a long time |
| **Q4/**<br><br>How much of your time do you spend on non-value adding activities in your interaction with PPL? | • By summarizing the work with PPL some factors contribute to non-value adding activities regarding the work, it would be better if the Feature Leader was early in the project informed about:<br>   o Customer Barometer / Heavy Truck Survey results that better link with how we need the feature status input for building the Actual Feature Position<br>   o 2) Wanted Feature Position input that is not stored to be confidentially available in one place and...<br>   o 3) "Feature Scenarios" telling about current trends and customer needs<br>• Too much time can be spent on searching for information<br>• Spend a lot of work on something that is later balanced<br>• In all the communication/interaction with PPL is efficient. The problem is that they rarely have enough time for the work needed.<br>• The interaction is quite efficient and valuable |
| **Q5/**<br><br>Referring to the Feature survey 2011 the average answer of how good the communication between FL and Design Engineers was 3,52 of a scale of 1- 5. | • The communication is very important because written requirements and CAD surfaces must be communicated directly with Design Engineers<br>• The communication and interaction is significant between FL and Design/chassis, both to communicate/clarify requirements and to discuss solutions<br>• The interaction should be by nature from both Feature |

| | |
|---|---|
| How important is the interaction/communication with Design Engineering in your work? | Leader and Design Engineer<br>• It is very important but difficult due to the large number of people to interact with and that the entire vehicle needs to take into account<br>• The informal decisions about requirement deviation or re-design usually are taken<br>• A lot of interaction between Feature Leader and Design Engineer to discuss detailed info of specific parts/techniques<br>• The communication makes it possible to establish a dialog history and that makes it easier to come forward when problems arise |
| **Q6/**<br><br>How much of your time do you spend on non-value adding activities in your interaction with Design Engineering? Please make a comment. | • Sometimes there is too much time spent on unnecessary discussions / argumentation where Design Engineers think they know better about requirement levels or have a hardship to accept requirement levels.<br>• It is important that Design Engineers and Feature Leaders stick to and fulfil their respective project roles and go ahead with the work instead of spending too much time on questioning.<br>• Spending time on packaging meetings, which are actually important, but sometimes most issues are not of interest regarding the Feature Leaders work<br>• Unnecessary meetings that is not of interest for the Feature Leader<br>• Most interaction is of high value<br>• The non-value can sometimes be about spending time in finding the right responsible person |
| **Q7/**<br><br>Referring to the Feature survey 2011 the average answer of how good the communication between FL and Systems Engineering/Requirements Managers was in 2,77 of a scale of 1- 5. How important is the interaction/communication with Systems Engineering in your work? | • The communication is very important due to that the Requirement Specification status is what is followed on a higher level by the project<br>• The communication could be done in a better way with better tools<br>• Unfortunately the RS is often not representative for the actual status though (due to lack of detail and coverage of the full picture)<br>• System Engineering have sometimes too strong link with project management instead of listening to the Feature Leaders.<br>• There have been occasions where requirements have been removed by SE / Project managers without Feature Leaders knowing, Very annoying and frustrating.<br>• The communication is not so good, especially |

| | |
|---|---|
| | considering the enormous mails that are coming now and then with excel sheets to sort and fill out |
| | • important to have this communication, but it could be done in a better way with better tools |
| | • There is no understanding of the SE role and influence in a project. "We have so much more requirements then those that they handle". |
| | • If this communication is poor, the project management will not give adequate support to the feature in case of issues |
| | • SE does not add much to the project, there is a feeling that the Feature Leaders only distributing information to SE and never gets response and deliveries back |
| | • What at least could be regarded is that SE deliver the requirements to the right receiver (often Design Engineer) |
| **Q8/**<br><br>How much of your time do you spend on non-value adding activities in your interaction with Systems Engineering? | • A lot of administrative procedures which some are not value-adding |
| | • Quite much of administrative work, and of re-mailing to make things happen. |
| | • Since a very small part of our feature requirements are included in the RS and since the colour only are showing the status at SP-start (and not the current status), it does not really add value to the work |
| | • There is a quite efficient work between Feature Leader and SE, writing good requirements: this must be considered as value adding, even if it takes a lot of effort in each project. |
| | • There are administrative procedures that SE wants help with, but after there is no use of those documents, non-value adding |
| | • To write in all the requirements in Excel document (very time consuming if many and not very easy to have a good overview in a big document (many columns). |
| | • Time consuming issues in this area is mainly to agree between sites about requirements |
| | • Quite confusing with "CORO", "Stakeholder" etc. |
| **Q9/**<br><br>To what extent is the competence/knowledge "within peoples head" instead of being documented within the | • There is a problem to find input about specific technical information about concepts |
| | • The main problem is rather that documentation structures are too complex to navigate in when searching information or that information is not summoned in one place. |
| | • The "white books" are not used in the correct way, |

| | |
|---|---|
| organization? | • never heard or seen anyone who have reused the contents of the "white books"<br>• "To a great extent I think, or maybe I'm not aware of what documentation that actually exists"<br>• People do not have the time to document which contribute to a lot of problems<br>• This is a large problem and a lot of information is lost when experienced people leaving the company<br>• There is a trend that fewer long term employees are about to leaving the organization and more temporary consultants are employed, contributes to risks of losing information, the knowledge does not stay in the business<br>• This issue must be improved<br>• I have noticed that decisions from meeting which was not written down /documented later on was "forgotten" in project |
| **Q10/**<br><br>Is there a structured way of how to interact with people from other functions (e.g. PM, PPL, SE) referring to your work? | • Decision structure where questions are handled at lowest feasible level via Packaging meetings, Cab complete, Engineering Design Meetings and Project Decision Meetings have solved a lot regarding getting conscious decisions involving all.<br>• The Feature Leader process regulates how and when these communication channels should be used.<br>• The Feature Leader process is not fully followed<br>• Yes, but these structures feels to be more for formal decisions, while the real decisions are already taken somewhere else outside the structure<br>• All people have come up with their own structured way of working and how to interact with the other functions (this cause problems when people are replaced<br>• This interaction should be more structured and the meetings should be more "non-strict" in order to provide more creativeness among the employees<br>• The System Engineering meetings and documentation are very strictly performed and structured<br>• The contact with other functions are often very random<br>• The structure is to some extent documented but in real life they are not followed, people build their own structure<br>• The GDP for Feature Leader/work which explain in a short and good way all the inputs and outputs at different gates. Not always the way things are done in daily work though. |

| Q11/ | |
|---|---|
| If no on previous question, would it be better for your work if there was a structured way of how to interact with other functions? | • The work would be much better if there was a structured way of how to interact with other roles<br>• If the communication would fail it is very good if there is a documentation of how to react and structure the work<br>• The structure must be easy reading and not too complicated, it is good to fall back to |
| Q12/ | |
| If yes on previous question, how would you want a structured work mode to be designed? | • It would be good if it could become clearer and harmonized how requirements and questions are sent to different commodities.<br>• How responsible design engineers of different solutions at different commodities get involved and aware of feature requirement<br>• It could be a documented way of how we actually work today that would have to be agreed by all involved<br>• Clearly define roles, responsibilities and what the critical points are in the interaction<br>• Today, it is up to FL to contact PPL and not the other way around. A structured approach of the interaction should specify how the communication should be designed and it should not be up to the individual personality if or not to contact a person within a project that has interest in a specific information<br>• There should be a review meeting of the pre requirement document<br>• PPL and SE should have planned regular meetings and not last minute ones<br>• There should be guidelines frames but not in detail specified<br>• More interaction with PPL and how they will give us input about future roadmaps |
| Q13/ | |
| Would a documented approach of how to interact with other roles/functions be of help in the future when new employees start working in functions interacting with you? | • A process picture and listed roles / responsibilities would help new employees, but it is equally or even more important that employees that have worked at Volvo for some time know that these things are valid<br>• It would make life much easier if the process clearly showed how and when to talk to different functions<br>• This document shall describe how we actually work<br>• The already stated documentation must be updated<br>• People can't just read in a document of how to interact with other people. People must meet and talk to each other, the physical meetings are of utmost importance<br>•   Free communication is essential but if it does not work |

| | |
|---|---|
| | a documented approach can be helpful<br>• When you are new you learn by searching and asking for info but it is very time consuming and takes a lot of energy. Documented approach could be very good to minimize this |
| **Q14/**<br><br>How much would a documented approach of how to interact with other roles/functions be of help in the future when new employees start working in functions interacting with Feature Leaders? | • It would not be a world saver, but would make it a lot easier<br>• If there was, it could save a lot of time for the Feature Leader<br>• If most interaction is made with one commodity it certainly helps if a Feature Leader is located at that commodity.<br>• Approaches is essential if there is no structured approaches, people do not know who should do what<br>• Everything can't be documented, some information must be learned by experience and /or mistakes<br>• A lot of help if there was an introduction of for example who to contact etc. |
| **Q15/**<br><br>Do you get updated information from other roles when new decisions have been taken concerning your feature or work? If yes, from whom do you get the information updates? | • The information is distributed directly from responsible design engineers, team leaders or project managers.<br>• Sometimes yes, sometimes no, it is not for sure that every time important information is distributed<br>• Design changes affecting "my" feature are rarely communicated<br>• This is very differently, but sometime decisions about "my" feature are taken when I am not attending to the meeting<br>• This issue is a mess, often Feature Leaders must on their own investigate if there are any changes<br>• The information is distributed from the other roles when new decisions have been taken.<br>• Some information just ends up to me<br>• From PM complete vehicle (mostly)<br>• New decisions comes from other Feature Leaders, Engineering, PPL, via email, Feature Leader Network<br>• We have however experienced situations where people do changes in design, material etc. where they do not know it will influence our feature. Suddenly we just notice a decreased level for the feature and start investigating why |

| Q16/ | • My feature role is firmly established within the organization. This means important information is distributed to me so I am aware. |
|---|---|
| Do you consider that important information regarding your work is distributed to you from other functions without the need of your request? Please specify if no | • From some areas/functions the information comes automatically |
| | • Design changes is rarely communicated and can be difficult to get information about |
| | • Must often run for the information myself |
| | • I really need to remind PM CV to do that, and mostly the work has to be done by me personally anyway. And thereby with limited interest from the receiver since I am lower down in the organization hierarchy |
| | • This is a real issue in projects, in the documentation it is stated that the Requirement Owner (Feature Leader) should be reported to about decisions regarding requirements and decisions in Engineering Meetings, Project Decision meeting, etc.. |
| **Q17/** | • Sometimes decisions are still made without me, even if I am a responsible influenced Feature Leader |
| Do you consider that other functions involve you in decisions that regard/affect your work? Please specify if no. | • This happens more when working with commodities that I have not got as much contact with |
| | • This is why there needs to be a structured process in place for the exchange in place, including role descriptions and an understanding of them |
| | • It is mostly by coincidence or by rumours. In many cases since they have not foreseen any affects for my feature. |
| | • From some areas/functions the information comes automatically, from some you need to drag it out, this depends on the people involved. Some people do not know the about the work that is performed or expect the wrong things |
| | • There is no structured way of securing it |
| | • I do not understand this question |
| | • In order to ensure when new decisions has been performed you as a Feature Leader must invite yourself to certain meetings/forums. Sometimes you are forgotten |
| | • When other people considering you as an expert then you are invited |
| **Q18/** | • The RS only looks at new solutions w/o considering requirement fulfilment of the Friday product that must also be fulfilled |
| How well do you consider that the Requirement | • The requirements within the RS are put at a too high |

| | |
|---|---|
| Specification document works referring to your work tasks? | level without the detailing required to develop corresponding technical solutions. There are much more detailed requirements in the actual project work<br>• The use of excel is not the best solution<br>• Sometimes difficult to write good requirements because we're missing reference values or competitor knowledge<br>• The RS grasps only 10-20% of the requirements needed to develop the product to the feature level corresponding to the Project Wanted Position<br>• It only covers work with new requirements. Not the work with carry-over Friday-Monday<br>• It works fairly well<br>• The RS is a very complex document which seldom is distributed to the right person at the right time, it is also difficult to interpret its contents and it is not a very relevant document for the Feature Leader<br>• How will products be better if we always refer to current situation without require improved values? |
| **Q19/**<br><br>With what document do you distribute the feature requirements to Systems Engineering's Requirement Specification? | • We utilize Excel to list the broken down Complete Offer requirements as well as the other necessary requirements to develop the technical solutions<br>• Outlook<br>• Power Point<br>• Fill in an excel document together with SE<br>• Word document<br>• A copy of the RS with requirements and comments written in |
| **Q20/**<br><br>Would it make your work easier if there was a standard template for filling in the requirements to send to Systems Engineering? | • The problem is they are not detailed enough, and SE is not willing to expand the RS to the required contents and detail.<br>• For the five physical Ergonomics features we have developed an Ergonomics Requirement Summary that includes all necessary feature requirements for developing a product. This has been verified in P2545 and is also used in P6225 and smaller on going PMRs. It is such a format that should be accepted for general use.<br>• Then the question remains if the RS should be owned by SE as part of the RS or if it should be owned by the Function where the Feature Leader is located (FVV or Commodity) for support in securing the feature levels from developed designs (wherever they are being developed). |

| | |
|---|---|
| | • It is almost impossible to fill in requirements to a template. The format differs a lot between different features and sometimes also between different projects. Best for me would be to keep the overall structure in excel or Serena, with detailed references to the word document<br>• I do not think this would solve any problems, the Excel printouts used in projects work fine as format. The Excel file which we uses today should be enough<br>• Yes if "standard" means the same layout each time. Very important though that we are able to write the requirements as they should be written in the standard layout in that exact project as it can sometime vary (depending on what systems etc. are new or modified). |
| **Q21/**<br><br>Are all important requirements included in the Requirement Specification? | • Not at all. Only 10-20% of the requirements and often important requirements are not represented.<br>• Carry-over requirements are not included in the RS. These requirements are supposed to be taken care of automatically, but there is a big risk that some are lost and/or modified on the way<br>• In the actual project requirements on more detailed level are used, so in the RS it is the requirements on a very high level<br>• Only if we fight for them<br>• It is the FL: s that writes the requirements, if they are not there it is because we have not filled them in. |
| **Q22/**<br><br>Is there a problem that "carry overs" or "M=F" requirements are not included in the Requirement Specification? | • This is a big problem! The pre-studies / projects only want to deal with the new solutions. However very often the new solutions / concepts can violate requirements that the existing solutions fulfil.<br>• There is a big risk that some carry overs are lost and/or modified on the way due to reassessment during the project. Carry Overs should be equally important as the new requirements<br>• The problem is that Engineering does not always know/understand what the Friday level is, and are not always aware of when they change things that that change will have an impact on other parts in the project<br>• M=F has sometimes been used even if new parts or systems are added, illogical and impossible<br>• In some projects the Project Management refuse to include requirements that are M=F specified<br>• Feature Leaders see the RS as a complete requirement map with all the requirements the product has to fulfil. |

| | Project Management considers the RS will be to detailed if all the requirements are included so they just want to have the new requirements specified. The M=F requirements should be documented somewhere else. But where this somewhere else is, is not well defined. |
|---|---|
| | • The RS definition is not anchored in the same way around the organization |
| | • Yes, as a requirement can be carry over or "old well know" requirement which should not be written because the new parts should not affect it. However something still can have changed affecting the feature so that an "old" requirement is not met. Then is tricky as it is not written in the req. specification |
| **Q23/**<br><br>If yes on previous question, why are "carry overs" a problem? | • The current product fulfils requirements that are often important for the drivers no matter what solutions or concept is providing the requirement fulfilment. When these "carry over" requirements are neglected, it leads to later surprises that anyway need to be dealt with - often to higher cost and lost development time and thereby endangering the project time-plan.<br>• Changed packaging with unchanged components (same part nr = carry over) could mean longer service time.<br>• They can be missed and often they are not met, due to various reasons. Then the discussion starts. The supplier does not have the requirement specified. They cannot meet requirements that are not described. NOK.<br>• Can in some situations e.g. regarding security requirements were the overall development and the change in the rest of the world requires a change of some requirements which might affect Carry overs.<br>• Important that everyone are agreed about the definition of the term "carry-over"<br>• If you have a red feature you must know the Friday value.<br>• Often a part that from a project point of view is seen as c/o isn't really c/o in a feature perspective (e.g. other position etc.) |
| **Q24/**<br><br>How can the work mode regarding "carry overs" be | • We need a more complete and detailed Requirement Specification. The established format of the Ergonomics Requirement Summary solves this (according to the knowledge established in the latest start cost pre-studies). (An additional solution - that however cannot |

| improved? | replace the ERS - can be to use "Super-FS:es / TR:s" that list all Requirements on Component Level. Annika Hermansen at Cab is looking into these data bases of RoCLs.)<br>• There should be a base req. spec. for the current product, and then the new project content is added<br>• Engineering should have more knowledge about requirements and feature levels in their area<br>• Well documented Friday values and have a more clear view what requirements should be documented where.<br>• It needs to be accepted that we need to include requirements also for c/o and that not everything is c/o in a feature perspective even though it is in a project perspective<br>• Let the FLs to include all features that need to be included, even if they are of carry over character. And this without all this administrative fight<br>• If there could be a database or a "requirement book/document" where all the requirements are which we have written over the years. Then we can go into that and if there are new specific requirements for a certain project we should add these new ones. Then easy to refer to an old requirement if it is not fulfilled |
|---|---|
| **Q25/**<br><br>Do you consider the Requirement Specification from Systems Engineering is a readable document? | • The Excel printouts from the RS I consider to be quite readable, but it can certainly improve<br>• The actual Requirement Specification is available in Serena that I am - despite having passed the course some years ago - not able to read directly. If the RS should be used for following up more detailed requirements on a daily basis this will form a big problem. Besides I am not at all sure Serena is as user-friendly as needed to support this daily work in an acceptable way<br>• A huge excel document with a number or rows and columns is not readable<br>• The document is too large and complex<br>• It is like viewing the world via a "toilet role", maybe that is why there are bursts in the project work, Design Engineer and Project manager can´t find all the requirements in the document |
| **Q26/**<br><br>If no on question 6, make a comment about what the | • The Serena data base is too difficult to work with directly<br>• Excel boxes, can easy be misunderstood. Translate it to |

| | |
|---|---|
| main issues are that makes the Requirement Specification difficult to read and understand. | word document. |
| **Q27/**<br><br>What does the word "contract" mean to you? | • "Contract" means an agreement between different parties at a certain time that should be valid onwards. If any party has a problem in fulfilling the "contract", this problem has to be raised to all parties being part of the agreement. A common decision is needed to decide on what to do. Breaking the "contract" should normally lead to some sort of penalty.<br>• A decided and already balanced requirement specification document (all features) signed and agreed by all project partners.<br>• A document that clearly states both parties ability and dedication to fulfil a task<br>• Decision taken at this time for the chosen design and feature impact<br>• It is more just "One more paper to fill in". Just some paper work. A copy of the feature review at FDCG. No one cares if we do not fulfil the contract. For some features it is possible to sign a contract at FDCG. For some other features it is not possible to sign a contract until maybe IG.<br>• Commitment<br>• An agreement that must be fulfilled or there will be consequences<br>• Sounds like there will be severe consequences if not fulfilled<br>• Contract is something I must keep to (or reach if a level or requirement) |
| **Q28/**<br><br>How much does the name "contract" affect your attitude to it? | • I think "contract" is good to highlight that it is an agreement that should not be broken<br>• In Gothenburg the word "contract" is not used that much according to what I am aware of. My understanding is that all the "contracts" for each respective customer feature at FDCG are bunched together to form part of the overall "Project Contract" at that gate. These FDCG feature "contracts" are very similar to the feature "status reports" at previous gate(s). In Lyon - from where the usage of "feature contracts" originally came - I believe they use each individual feature "contract" in a much stronger way. I have myself experience from that in the P1010/11 |

| | |
|---|---|
| | project back in 2003-2006<br>• I think it is an unfortunate choice of word. Something like "delivery agreement" or similar would make it less dramatic<br>• The important thing that all involved are completely clear on the significance and meaning of the document and the content<br>• Negatively<br>• Sounds very serious and also when you hear project managers and at the GDP- course they say "you sign in blood"<br>• I do not feel responsible or have the authority to achieve tasks/objectives/requirements, but only to follow up on their progress |
| **Q29/**<br><br>What is good with the use of the contracts? | • It becomes clearer that this is a sharp situation where a firm agreement is very necessary to achieve in order to avoid later trouble. Every stone must be turned and risk investigated so that all involved can be sure that the product will work and provide the agreed feature levels<br>• A possibility to come to a final agreement of project content and achievable feature status and what has been committed in the project<br>• Should be less easy to balance requirements later on in the project; any deviations should be treated just as deviations and not as balancing. But this is not always the case.<br>• That we review the status in more details than usually<br>• I guess it is good to officially agree on what the project shall deliver. But on the other hand that is made by the RS all through the project.<br>• I do not think that we use contracts. What is it?<br>• It makes us stop and think extra on what level that shall be met in this project.  It is good.<br>• It is very similar the FL status reporting, that documentation should be enough. If there shall be a contract there must be a differences between a contract and the last feature status that is performed<br>• Nothing as it is today.<br>-The contract is reflecting the targets/ambitions of the specific project that all involved parties have agreed upon.<br>• - A written agreement,<br>• -I haven't worked with contracts<br>• Good if it is really used as "info of what we actually all |

| | |
|---|---|
| | agreed at FDCG to reach at SP".  Sometimes very early to know at FDCG though what we will actually reach at SP as testing and real parts are coming more and more late in many projects (after FDCG so there are no time for problems or loops). |
| **Q30/**<br><br>Are there any problems with the use of the contracts? | • As mentioned above, I have not felt that we have that firm usage of them in Gothenburg. I think it could be good to raise the status of the "contract", but I am not sure that the process would need to become more formalized than it already is in Gothenburg. (In comparison it used to be much formalized in Lyon where each person signing the contract should put their actual signature at the bottom of the contract page. This would probably mean the Feature Leader would need to join a series of meetings together with the other persons who are to sign it. In the meetings everyone would discuss and get convinced about that everything is in place.) I believe our structured way of working with different responsibilities and roles in pre-studies and projects.<br>• I know very little about them<br>• They are not treated as contracts by all the Design Engineers<br>• Impossible to fit all requirements into the current template<br>• Too pompously and in the end I can't be judge for breach of contract anyway…<br>• All involved parties/function that are included in the contract do not have authority to fulfil it.<br>• It might be better to rename "contract" to something else<br>• We have confidence in chassis/cab to solve our issues without the use of a contract.<br>• They feel a bit "stiff"<br>• Feels very serious as mentioned, do not feel that is a "help" for us as it is often mentioned. |
| **Q31/**<br><br>If yes on previous question, please state what can be improved/changed with the contracts. | • I think the importance of the "contract" could be underlined more by project management and all people involved in establishing and being responsible for the "contract". However, I do not think that the "contract" necessarily needs to have another format than the ordinary status reports used at other gates<br>• I am also thinking that the importance of the gates have changed over the last years so that the actual gate |

| | |
|---|---|
| | <ul><li>that becomes important is the Development Gate. This means that people have a bit hard to find the "contract" at Final Development Contract Gate as important, and they wonder a bit why something similar was not highlighted at the DG. It becomes a pedagogic problem</li><li>They have to be signed by managers with mandate</li><li>Why can't we use the Requirement Specification to make a sign-off on each requirement instead, Then all requirements would be secured and taken into account</li><li>Change name to example "Agreement"</li><li>Write the contract at different gates for different features. Some features require physical verification before you can know that the design will fulfil the required feature level. Or you can add a very large safety margin to the contract level (e.g. you write a requirement that you aim for, then in the contract you write a much lower value.)</li><li>Guidelines</li></ul> |
| **Q32/**<br><br>What is the purpose of using the contract according to the organization? | <ul><li>A contract between parties that should be followed onwards. However, this is probably more from the general understanding of a contract from outside Volvo (e.g. when buying a house) rather than a specific understanding of what a "feature contract" means inside Volvo as part of the Global Development Process</li><li>A possibility to come to a final agreement of project content and achievable feature status between FL's, brand representatives and Design Engineers</li><li>All involved are committed to what has been contracted, that both parties agree on requirement to fulfil</li><li>I do not know</li><li>The organization hasn't told me</li><li>Confirming about what will be delivered and possible later identify deviation from contract agreement and</li></ul> |
| **Q33/**<br><br>What do you think of the purpose of using the contracts? | <ul><li>I believe it could be very good if the importance of the "contract" was more underlined so it can be used to get focus at a crucial project stage when all need to secure a good enough status</li><li>It can be good to have it on paper, but I still have confidence in the solutions without a contract</li><li>I think they work OK in general. But they do not cover old requirements, because they are not involved in requirement spec</li><li>As it is today</li></ul> |

| | |
|---|---|
| | - It should point out what the project shall achieve and be a guide line to involved functions<br>- Good if it is really used as "info of what we actually all agreed at FDCG to reach at SP" |
| **Q34/**<br><br>How do you perceive the purpose of the contract? | - I see it as an agreement on what requirement level the project agrees to deliver<br>- To state what level of feature we deliver a truck to our end Customer<br>- Good, but often the project situation changes after the contract and targets in contract are hard to reach<br>- It should point out what the project shall achieve and be a guide line to involved functions<br>- -The intention is good, but I think everything would still work OK without it<br>- If we can't agree at this project state there is not likely to happen later<br>- Good with a "handshake" on deliveries<br>- We are told to send it out in a mail to certain specified people (PMCV, PPL etc.) with a template contract mail we have. Never get an answer though to these mail if they accept or not. Just assume it is ok as they do not say otherwise and we are told the contract are put in the project description and therefore documented |
| **Q35/**<br><br>How do you perceive the anchoring procedure of the contract? | - I do not believe the anchoring procedure is clear enough. It is not obvious that you are in an anchoring procedure even if you should be. The important gate is starting to become the DG instead of FDCG. Activities regarding requirement fulfilment get a bit more intense at a certain stage, mainly due to that System Engineering start to require that no yellow items must remain. To me it has not however been clear that this is in order to secure that feature contracts come into place. Instead it has been a question about the overall project status. This is my experience of the procedure, if there is one<br>- It feels like a non-binding contract, something that has to be done but does not mean so much<br>- I've only experienced one contract (eu6) and I do not know if there was an any anchoring at all<br>- Not working. Need to organized in a more structured way<br>- It is not clear what you are actually signing in the contract |

| | |
|---|---|
| | • Is it that you must fulfil each requirement in the requirement specification to 100%? Is it that you should fulfil the target in the pre requisites to 100%? The target is often very vague so depending how you interpret the target you can always say you fulfil the target.<br>• It is ok |
| **Q36/**<br><br>How much value adds the use of contracts to your work? | • It does not add that much today, but it could and should for sure add a lot, for example: 1, Making sure enough is made to secure a good level which will avoid extra work later. 2, Making sure all main parties accept the existing feature levels and technical solutions, and try to stick to them onwards to maybe better avoid later deviations, 3, Support introducing an additional way to measure project quality, if project managers are doing a good job supported by the project members or not<br>• Positive to have it on paper, but still no issue without it<br>• It strengthens the feature<br>• It is better than nothing |
| **Q37/**<br><br>Did you get a clear and structured introduction to the work tasks when you started as a Feature Leader? | • I read the process documents, but it was very hard to understand with all abbreviations<br>• No not really<br>• No introduction at all. But the work was not new to me<br>• I would like to have 1 person as Feature Manager, preferably Mr. Anders B. Berle, but someone else is quite OK<br>• All information and direction of what Feature Leaders shall do would come this way.<br>• It was more "learning by doing<br>• Yes, as good as one can expect, but there are room for improvements<br>• I believe I was lucky to join the activities when Volvo merged with Renault and there was a lot of common work to build a common basis for the feature work (developing feature breakdowns, etc.). This was done as driven by the FCT Driver Environment (where former FCT leader was very active and had a responsibility for feature development in general).<br>• Yes for the main parts that I should take care of but not for all tasks since I am not the formal leader<br>• Limited time for "going hand in hand" in the handover of projects/PMR<br>• Very much self-studies and not so much mutual |

| | introduction |
|---|---|
| | • More or less only access to the team place |
| | • .Not really. I got some documents to read and some tips etc., but otherwise it was learning by doing |
| **Q38/**<br><br>Have you read the training material for Feature Leaders? | • No. Wasn't aware of its existing<br>• Is there are Training material?<br>• It helps to read the training material during introduction, but it is not possible to understand how to use it in practice to the full<br>• Maybe something on the team place<br>• I think I read some material<br>• Need more! |
| **Q39/**<br><br>If yes on question 2, to what extent has the training material helped you in your work as a Feature Leader? | • It helps a bit, but most of it is learning by doing<br>• I do not know?<br>• Since I have worked as FL for rather a long time I have not really used the training material as such.<br>• It has given an overall overview of the roll and other involved functions/areas within the company.<br>• Since I can't really remember I do not think it was to great help, but that it gave an insight |
| **Q40/**<br><br>How easy is the training material to understand? | • I think it is very easy. There are several very useful illustrations that also try to illustrate things in different ways that probably makes sure people with different background can understand what is meant<br>• A few more examples would not hurt. I think it would also be good if the "flowchart" (list with "Input", "Feature activities" and "Output") should be included to a greater extent. That can form a main support for a new Feature Leader - to know what should be done at each stage and to know who are the main persons to be in contact with<br>• Not too bad now when I have worked a "few" years.<br>• The material includes a lot of internal shortenings that makes it very difficult to understand and to put everything in its right place<br>• GDI is very compact but good after quite sometime of working in the role as you learn during a long time. But very time consuming.<br>• The overall structure is OK, but for a non-experienced it is rather difficult to follow<br>• Do not remember<br>• Since I can't really remember I do not think it was to |

| | great help, but that it gave an insight |
|---|---|
| **Q41/**<br><br>What would you want to improve in the FL training material? | • Some good examples that can suit any of the 34 customer features, easier to understand document with some practical tips<br>• Training in leadership, how to present and discuss on issues and how the FL-role is in general in a better way.<br>• Overview over the "flowchart" with activities at any pre-study / project stage and how it can be used as support for new Feature Leaders<br>• Added explanations about Development Loops and how they steer the activities for a Feature Leader. (DLs are a fact and very important for making sure everyone work at the same speed, i.e. for sticking to the time-plan.)<br>• Put more emphasis on virtual development with simulations and use of computer or CAD models. It feels like too much focus on later verification & validation stages<br>• Needs to be updated with the latest organizational and process changes.<br>• Add a more basic training material, but keep the full/complex versions. Adapted to receivers with limit knowledge of the work processes and truck company/technique |
| **Q42/**<br><br>Does the training material contain relevant information to you as a Feature Leader? | • Yes, definitely.<br>• Not as a beginner<br>• Yes, it is fairly good but on a general level. Does not really help you in your daily work when you have problems or questions.<br>• Do not know have not looked into it<br>• Would need also more about what are the PPL responsibilities regarding e.g. roadmap for the feature, what is mine as FL and how are we to work and interact. Also more regarding Systems Engineering and requirement work (how to write good requirements, how the SE process is etc.) Some of this SE issues have been tried to covered during many meetings at FL GOT (Mr Anders B. Berle´s meeting) but has taken long time etc.<br>• I think it does |
| **Q43/**<br><br>To what extent are new | • I think it is fairly poor in general. With the routines we have started to utilize for the Ergonomics team, I believe it can be quite good. I think it is necessary that |

| | |
|---|---|
| employees introduced to the organization, training material and process documentation? (What you are aware about) | people with experience of working with the specific feature / feature area need to provide the education and also work as "mentors" until the new Feature Leader gets up to speed. A procedure for introducing new Feature Leaders that include regular support meetings during the first year would give additional assistance except from an introduction followed by a two weeks training period in parallel with experienced Feature Leaders.<br>• It seems there is no time or resources for proper introduction<br>• They/we often not have time for it and get through into work without a good background<br>• Nothing is not to be considered as OK<br>• Had almost none as beginner<br>• Introductions could probably be improved and more structured<br>• My feeling is that there is no introduction<br>• What I am aware of its quite poor introduction for new employees/consultants. You are expected to deliver right away |
| **Q44/**<br><br>Do you consider there are any problems with the use of the traffic light when status reporting in projects? | • I think the traffic light explanations within the training material gives very good support on what colour should be reported<br>• Unfortunately, all is not black or white in the real world. And sometimes the project wants us to grade the level of red or yellow (is it "Red-red" or just "Red???")<br>• Hard to use yellow at "gate status" because then template states it must be green at SP. But we can be uncertain at this point (yellow due to off track), but automatically not promise we will be green/ok at SP. If we show yellow and then automatically green at SP (even if we have some idea how it could be solved but testing/verification is needed) it is easily taken as "ok it is green by SP so probably no big issue"<br>• There are problems when it is not clear exactly what the meaning of the colour is or when it is not clear what kind of status that is reported (COSP, CORO, STHLD for example)<br>• It can be difficult to say when you have a certain colour, but it makes a clear message to the project how it is going for the feature<br>• Very narrow minded, we might have many ideas but not be sure they will solve issue due to cost needs to be |

| | |
|---|---|
| | evaluated, design, possibility to get in implemented etc. |
| | • Easy and crystal clear. |
| | • When the method is mixed with other internal methods it can be a bit messy |
| | • Sometimes difficult to judge which colour to use since all issues are not so "black or white" |
| | • Mostly it works OK |
| | • It is not very clear when to put yellow and wen to put red. It is different depending on how each FL interprets it. |
| | • There seems to be different opinions of how to use it and also the meaning of each colour. |
| | • It is seldom 100% clear what colour to set. You can always argue against |
| | • I think that we only should report the current status colour, since it is the most important information to share with the project and to know which parts need to focus on. The current status colours will automatically say which colour it will have at SP anyway |
| **Q45/**<br><br>If answering other than excellent on previous question, give suggestions of how to improve the use of the traffic lights. | • Maybe it is about time to discuss this issue on FLGOT and get the view about what people actually thinks and then research outside CV. There must be a general view of this |
| | • Think the systems works OK. It is more determining which colour to use due to circumstances. The actual traffic light principle is fairly clear |
| | • Would like at review to not have traffic lights but to show status "this is where we are today", what problems /issues we have and what we are doing to solve them and finally if we foresee we will reach target level at SP. Close to the traffic lights but to state the exact colour from the template statement gives issues each time... |
| | • There should be a common detailed strategy/instruction of how to use the traffic light. All parties should have a common understanding of how to use it and the receivers should be aware of the meaning of it. |
| | • Difficult to say maybe only red or green. Otherwise a set of question you should answer to get a guideline |
| | • I think that we only should report the current status colour, since it is the most important information to share with the project and to know which parts need to focus on. The current status colours will automatically |

| | say which colour it will have at SP anyway |
|---|---|
| **Q46/**<br><br>Do you think that the Project delivery Plan, PDP is applicable on your Feature? | • I think it can be applicable. I have however not used it as it has not been required.<br>• I do not know what that is really.<br>• I am not familiar with PDP<br>• It is possible to use but is not really suited to my features<br>• It is more adapted to features that have a natural progression through the project (e.g. Reliability, Durability, etc...).<br>• The V&V-plan should correspond to the PDP<br>• Yes, but it needs a very huge work to define a good PDP at right level of detail<br>• I haven't worked that much with the PDP, but from what I have understood the original purpose of the document is not really fulfilled |
| **Q47/**<br><br>What do you think of the PDP? | • Good if it works<br>• I have still not seen the PDP plan<br>• It is good intention to have a document to follow up the project deliveries and fulfilments<br>• Another document to fill in and keep updated |
| **Q48/**<br><br>Is there anything you would you like to change with the PDP?  I | • It is OK as a concept and to have deliveries to each gate.<br>• Could possibly be integrated into the Req. Spec.?<br>• If we are to use it should be used in every project and really followed up.<br>• The PDP should be synchronized with the V&V plan<br>• Use the PDP as it is supposed to be used. Today it is used in a wrong way.<br>• I haven't worked that much with the PDP, but from what I have understood the original purpose of the document is not really fulfilled |
| **Q49/**<br><br>What do you think of the balancing procedure? | • More structured work and time given so that it will be avoided that the Project Manager makes the balancing decision at the end<br>• More account on the balancing history of a certain feature requirement. Sometimes the same requirement level has been balanced several times before and still balancing continues to a level that is very far from the initial target |

| | |
|---|---|
| | <ul><li>Better templates are probably needed to clearly show on what basis balancing is made and what consequences balancing will have</li><li>Everything must be Green at FDCG, regardless of actual status. If not Green, it will be balanced to Green and the issue is put on a risk list that will never be seen or followed-up afterwards</li><li>It is unclear, I do not know of any process for balancing but still I have been in a lot of balancing (done different each time)</li><li>There should not be any balancing after FDCG, only deviations.</li><li>Important though that the "balanced level" not becomes Friday level in next project</li><li>It is to slow and it happens in different meetings/forums. Could be improved!</li><li>Every time people must improvise</li><li>It is a necessary procedure and it has to be done<br>The project very often wants us the FL to do the balancing. That is not our job. We can tell the feature level and what the consequences will be if we won't fulfil the requirement. Then it is up to the project and PPL to do the balancing.</li><li>Not familiar with the procedure</li><li>It  should not be called balancing, since the requirements are just not respected but deleted from the project</li></ul> |
| **Q50/**<br><br>Is there a clear and structured way of how the balancing should be performed, i.e. who is responsible and who should be involved? | <ul><li>System Engineering has a process with different steps that should be followed along a predefined path (ending with that the Project Manager makes the decision if previous steps are not successful). I think each step needs to be described more in detail, what different roles should be doing in order to reach a balanced requirement level at an as early step as possible</li><li>It needs to be recognized that balancing takes time.</li><li>Balancing needs to take place continuously in small steps all along the pre-study</li><li>best thing would probably be that the most knowledgeable people get locked up in a room for some days to sort out the balancing with an open mind</li><li>No, very much up to the FLs to "fix"</li><li>There is a process, but I do not know if it is followed the whole time</li></ul> |

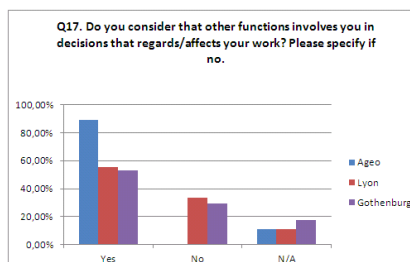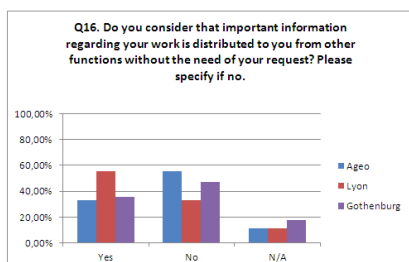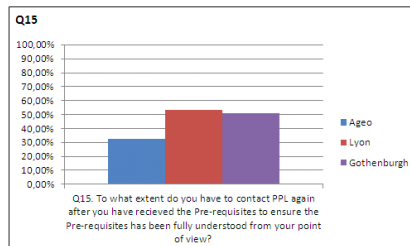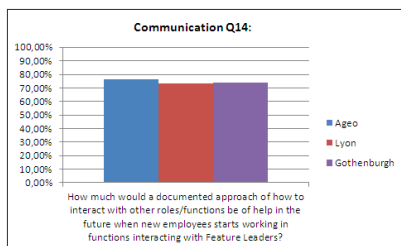| | |
|---|---|
| | • I do not know if there is an official procedure<br>• Still unclear in many cases who will decide what, and who will drive the issue (call to meetings, etc...)<br>• No clear process exists what I know. Is there an instruction? |
| **Q51/**<br><br>Would you like to change anything in the balancing procedure? Please specify. | • More face-to-face communication.<br>• More structure where the only the necessary persons get connected to sort out the balancing<br>• Better involvement of Feature Leaders in all issues that influence their respective features.<br>• More experienced people leading the balancing. (I think it would be good to have a new role - e.g. "balancing specialist" - that will provide guidance and support to project member for the continuous balancing through the pre-study / project, but that will also lead balancing sessions (like e.g. FMEA specialists are already doing).<br>• A common, structured and communicated way on how the balancing should work with guidelines and procedures<br>• A clear process with clearly defined roles<br>• Someone responsible to inform: "now it is balanced"<br>• It is to slow and it happens in different meetings/forums<br>• Not clear who should be included all the time and decisions can be changed a lot of times |
| **Q52/**<br><br>Do you think that the projects follow the GDI? | • I think the GDI 960-13 is very good and in many ways represents how we should work in projects. There are however far too many examples where Project Managers deviate from the GDI, and try to introduce completely different set-ups for running their respective projects.<br>• Another problem is that main GDIs governing different important participants in a project do not correspond to each other regarding timing, what level should be achieved when, etc.<br>• People in general have far too little knowledge about the GDIs (Project Managers, Feature Leaders, Design engineers, etc.).<br>• Criteria's to be fulfilled prior to gates are not followed<br>• If the GDI and/or GDP had been followed completely, not a single project would reach SP. There are always ways to pass gates without all criteria's fulfilled, the SP is more important than the status of the project<br>• Not the Electrical part of the project |

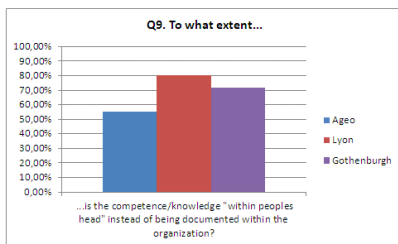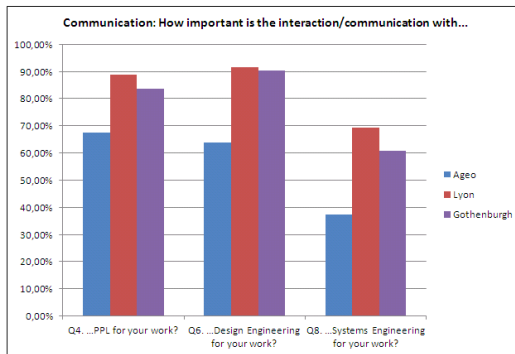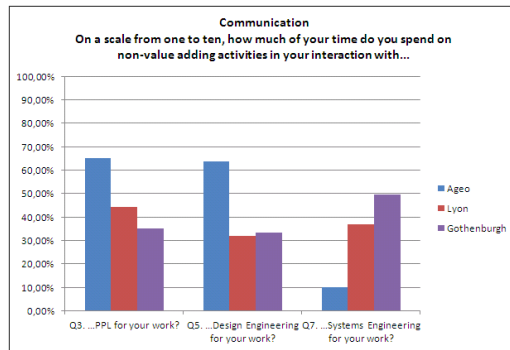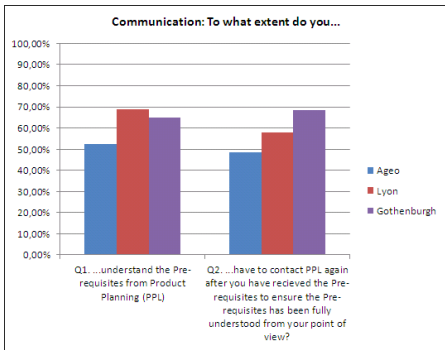| | |
|---|---|
| | • Not really. The projects follow selected parts of the GDP as they see suitable<br>• No not always, Sometimes it is said that GDI needs to be rewritten after "this" record braking project<br>• Both yes and no, depending on how big the project is etc. |
| **Q53/**<br><br>If no, do you consider it is a problem? | • Yes, it becomes a big problem when all should try to work towards a common goal at the same speed.<br>• It is better to stop and not open a gate, fix the problems or change the ambition level, rather than passing the gates with doubtful status and/or maintained ambition levels that are later found to be impossible or very expensive to fix<br>• People might not know it and just work by their on heads<br>• Of course, we cannot verify the complete solutions on time. All systems has to be at the same level<br>• Not really, as long as the important things are done and considered<br>• We pass gates on very uncertain states. If there are problems we need to solve them, if they are solved too late-> they will be costly and maybe not feasible.<br>• Some flexibility must be allowed but you need some solid guidelines |
| **Q54/**<br><br>If no on question 9, have you experienced that the PMs/project has set their own process for the project? | • In one project is worst case example; completely new systems were created instead of sticking to the established Vehicle Module structure.<br>• Feature Review should not be used, instead the Design Reviews were thought to be sufficient for following up feature status...<br>• Project Managers were removing requirements w/o involving Feature Leaders responsible for those requirements.<br>• The gates in P2540 have been moved and/or renamed in order to pass without all gate criteria are fulfilled<br>• Absolutely. I have just had a PM that had no idea what the role of a FL is. It is common that PM not follow GDP<br>• It something that the FL must run this issue on their own<br>• It is not always necessarily a bad thing |

| Q55/<br><br>If yes, do you consider it is a problem? | • Such things must be avoided! It is very important that we follow a general best-practice way of performing pre-studies and projects if we should secure QDCF with shorter lead-times and improved products as a result. It becomes a mess if pre-studies and projects deviate too much from the standard agreement. (Of course there should still be room for adjustments and improvements, but there must be a general back-bone that must be left untouched.)<br>• It is much better to stop and fix the problem than to march on with blinders hoping for the best<br>• Everyone must respect the project plan |
|---|---|

# Communication



Communication: To what extent do you...



Communication
On a scale from one to ten, how much of your time do you spend on non-value adding activities in your interaction with...



Communication: How important is the interaction/communication with...



Q9. To what extent...



Q11. Is there a structured way of how to interact with people from other functions (e.g PM, PPL, SE) referring to your work?



Q12. If no on Q11, would it be better for your work if there was a structured way of how to interact with other functions?



Q13. Would a documented approach of how to interact with other roles/functions be of help in the future when new employees starts working in functions interacting with you?



Communication Q14:



Q15



Q16. Do you consider that important information regarding your work is distributed to you from other functions without the need of your request? Please specify if no.



Q17. Do you consider that other functions involves you in decisions that regards/affects your work? Please specify if no.

XXXVIII

# Requirement Specification

**Contract**

Contracts Q30: Are there any problems with the use of the contracts? Please make a comment (see comments for more information).



Q33



Contracts Q36

# Training material



**Q37. Did you get a clear and structured introduction to the work tasks when you started as a Feature Leader?**



**Training Material Q38: Have you read the training material for Feature Leaders?**



**Q39, Q40, Q43**



**Q42. Does the training material contain relevant information to you as a Feature Leader?**

# Additional



**Additional Q44: Do you consider there are any problems with the use of the traffic light when status reporting in projects?**



**Additional Q46: Do you think that the Product Delivery Plan, PDP is applicable on your Feature?**



**Additional: What do you think of the...**



**Additional Q48: Is there anything you would you like to change with the PDP? If yes, please specify (see comments for more information).**



**Additional Q50. Is there a clear and structured way of how the balancing should be performed, i.e. who is responsible and who should be involved?**



**Additional Q52: Do you think that the projects follows the GDP/GDI?**



**Additional Q53: Do you consider it is a problem that projects doesn't follow the GDP? Please make a comment (see comments for more information).**



**Additional Q54: Have you experienced that the PM/project has set their own process for the project? Please make a comment (see comments for more information).**



**Additional Q55. If yes on Q54, do you consider it is a problem? Please make a comment (see comments for information).**

## Appendix D: Experiment template

| Experiment of Non value adding activity | Set a I | | | | | | | | | | Total time spent on non-value adding or interupting activities during the day | Comments: |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -Set an I every time the activity reapets during a time interval.<br>- Please make a comment in the end if you want<br>-All time states in minutes. | | | | | | | | | | | |
| **Unnecessary e-mails /E-mails that does not concern your work** | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| **Interrupted about something not concerning your work (Set a I for each interuption)** | | | | | | | | | | | | |
| How Long time did the interruption take: | | | | | | | | | | | | |
| How long did it take go back to the activity you worked with: | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| **Interrupted about something concerning your work (Set a I for each interuption)** | | | | | | | | | | | | |
| How Long time did the interruption take: | | | | | | | | | | | | |
| How long did it take go back to the activity you worked with: | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| **Participate at meetings that does not concern your work (Set a I for each meeting)** | | | | | | | | | | | | |

# Appendix E: Features involved in executed sessions

| Site / Feature | GOT | LYON | AGEO | GREENSBORO |
|---|---|---|---|---|
| **Average speed** | -Training Material evaluation | | Survey? | |
| **Maintainability** | -Individual interviews<br><br>-Experiment | -Individual Workshop | | |
| **Durability** | -Individual interviews<br><br>-Cross Functional Workshops | | | |
| **Driveability** | -Training Material evaluation | | | |
| **Entry/Exit** | -Individual Interviews<br><br>-Focus Group | | | |
| **Fuel Economy** | | -Individual Interviews<br><br>-Individual Workshop | | |
| **Visibility** | -Individual interviews<br><br>-Focus Group | | | |
| **Handling** | -Individual Interviews<br><br>-Cross Functional | | | |

| | | | | |
|---|---|---|---|---|
| | Workshop<br><br>-Documentation Flow analysis | | | |
| **Collision Safety** | -Individual Workshop<br><br>-Focus Group | | | |
| **Collision Compatibility** | -Individual Workshop<br><br>-Focus Group | | | |
| **Driver Position** | -Individual Interviews | | | |
| **Driver Interface** | -Individual Interviews | -Individual Interviews<br><br>-Cross Functional Workshop | | |
| **Personal & Vehicle Security** | -Individual Interviews | | | |
| **Ride comfort & Vibrations** | -Individual interviews<br><br>-Focus Group<br><br>-Experiment | -Individual Interviews | | |
| **Resting Comfort** | -Individual Interviews | | | |
| **Working Comfort** | -Individual Interviews | | | |

| | | | | |
|---|---|---|---|---|
| **Transport Security** | -Individual Interviews<br><br>-Experiment | | | |
| **Vehicle Agility** | -Individual Interviews<br><br>--Training Material evaluation | | | |
| **Suitability for bodywork** | -Individual Interviews<br><br>-Training Material evaluation | | | |
| **Quality Impression** | -Training Material evaluation<br><br>-Experiment | | | |

# Appendix F: Identified problem areas

| Identified problem areas | Functions | Information of the problem |
|---|---|---|
| Carry Over<br><br>M=F | SE, FL | • The definition of what Carry Over means must be 100 % stated, because SE uses the term "Carry Over" on wrong issues.<br>• It is the FL responsibility to decide what the technical requirement should be in order to get the value eight for example (among best). Even if the requirement from PPL/VTC is Monday equals Friday one has to improve oneself because the value eight today might be a seven or even a six in two years compared to the competitor due to that the competitor is improving itself. It is difficult to know what the competitors might develop in the future and hence one might not have fulfilled corresponding requirements and hence not fulfilled an eight. Then one has to make a PMR (project modification request).<br>• Monday=Friday is a very unclear terminology – it is not clear what is meant when we are saying that the new truck should be equals the Friday vehicle.<br>• Many Friday req. are missed due to that no one knows of the Friday requirements because they are not specified in the RS.<br>• In a new project the most pre requisites are the same as on previous trucks, i.e. carry over's. Carry over requirements are not included in the Requirement Specification, RS. New employees might not be familiar with what and which the carry overs are and hence they might not consider them when constructing. This results in unnecessary new designs of things that we already know how to design. Hence there should exist a requirement specification that includes all old requirements |
| Balancing | FL, PPL, VCT | • There is no general looping activity when balancing. Do not know exactly who to talk to.<br>• Req. Balancing: PPL often takes the decisions about the balancing. But if the project doesn't come further because FLs are disagreed, then the CPM can decide |

|  |  | in the end together with PPL which requirement to go for. Old PMCV (now FVV) is not involved in these forums. |
|  |  | • When requirements are balanced they should be specified in the RS in an own column. Note down about the balancing and which meeting this decision was taken. |
|  |  | • The process says it is SE that balancing the requirements, but that scenario have I never seen |
|  |  | • It is not official who owns the balancing activity |
|  |  | • There is no structured way of how the balancing is supposed to be made and there are no requirements on documenting who approved the balancing. |
| The Contracts | FL, PPL, PM, SE | • There is no explanation about why the FLs are using the contracts. |
|  |  | • There is no point in using the contracts, it gives no value to the work |
|  |  | • The contract is meaningless |
|  |  | • There is no approach describing how to work with the contracts. |
|  |  | • The contract writing is not time consuming, but if all the different functions are supposed to look at the contract, several hours will be spent on them. |
|  |  | • Just because the FLs do not understand the contracts, it creates an uncertainty to the FLs and their work |
|  |  | • The idea is good. It is good to have a discussion with design/analysis about which requirements we think we can fulfil. |
|  |  | • However, the template is not very useful. It doesn't cover all ~50 requirements, just a few. More or less copy paste from the feature review template. |
|  |  | • It would be more efficient to have an extra column I the RS or such. |
|  |  | • What happens if you do not deliver? What happens if you do not sign? |
|  |  | • In Sweden it has been an issue due to name "contract", Swedish people feel that it is something that is written in stone so to say.  In France the name Contract might not mean exactly the same as in Sweden. |
|  |  | • In Sweden, the contacts mostly results in that one has to sign it but really does not care what he or she signs while the Frenchmen are more used to that way |

| | | |
|---|---|---|
| | | of working. Hence the contracts feels like unnecessary paper work and it results in that one has to write down the requirements that cannot be fulfilled on a "Risk list" since everything has to be green at a gate in order for the project to proceed.<br>• PPL asks the FL to be among best on Driver Interface. At FDCG FL agrees together with PPL (mainly) to what level the feature will be (scale from 1-10; competitive/among best/ leader etc.). Contracts the former RVE: Ron de Vou Enterprise. It is done due to make sure that everyone is committed to the choice on the scale, e.g. competitive.<br>• There is a need for smaller contract updates to take into consideration that the work changes. It is difficult to add things after FDCG. By not taking into account smaller changes we will have difficulties to make it right the first time.<br>• It is good to have a document on what has been decided, especially in a global organization.<br>• Requirement specification and contract is for me the same thing.<br>• Does really the FL needs to sign the contract?<br>• Meaningless because the same information is in the RS and FR-template which are official for everyone. Contracts are unnecessary!!! (The project signs that this is the req.- level it can deliver to SP-start).<br>• The contracts are in practice not used in the right way. The word has a certain meaning for people maybe that's way it does not work properly in GOT. The contracts could be good if one aims to get people to think a little extra and for getting commitment.<br>• I do not recognize that the contract is to be signed in practice actually. |
| Risk List | FL, PMFVV | • If there is a requirement that can't be agreed between different stakeholders, and the project does not accept balancing, the requirement can be set on a risk list.  This is a way of walking around the problem since it is required that everything should be green at CG. There is no follow-up on the requirements on the risk list that I know about. Either PM or PPL/VTC that decides what decision to make. |
| | All Functions | • People CC:s all different kinds of people without being sure or not if they actually need to CC to all people when calling for a meeting for example. |

| | | |
|---|---|---|
| Mail | | • The time it takes to look up if this meeting is important for the FL´s to go on or not is often very consuming, because there are plenty of mail-meetings sent out during a day.<br>• It's not only time consuming, it's also annoying. |
| Communication | All functions | • There are very many people to talk with for FLs on features that are widespread as these two.<br>• People believe that you are an expert, who you should be, but if you are new as a FL you can't possible know everything.<br>• FLs have not much contact with PPL.<br>• It was a closer contact back in time between FL, PPL and SE<br>• FLs have not much contact with PPL.<br>• Poor communication with Powertrain because they are working in another structured way<br>• Live meetings – Information is missed out due to language differences<br>• FL does not get the correct information at right time from Design (Construction)<br>• Poor communication between test and calculation |
| Uninformed | FL, Design Eng., PPL | • If Construction has a tech. problem, sometimes construction goes to PPL without informing FL. And then has Construction/PPL decided something new that FL doesn't get information about and has no. Decisions taken in the project must be documented. When having PDM all the decision must be documented and available for all the stakeholders so all people know what has happened.<br>• FL are not informed about the decisions taken because PPL does not report back to FL and PM, FL and PMCV (=PMFVV) have not been informed because they weren't either invited to the meeting.<br>• Always is there changes I was not informed about, it shows out on the feature review if the FL is not updated about some decisions<br>• It is rather common that design comes directly to PPL to get something cleared instead of telling the FL first, probably because then they know it will be cleared because PPL said so.<br>• People are not always informed about important decisions. FL is not part of the Team project (Maybe that is the issue). |

| | | |
|---|---|---|
| | | • Difficult to be aware of changes in big projects. |
| Team Place | FL | • Difficult to find information quickly.<br>• Often you need to have access to different functions within the Team place.<br>• It is not very time consuming but employees get very annoyed about this procedure. |
| Breaking down Req. | Chassis commodity | • Chassis Commodity has sometimes difficulties in breaking down req. to modules, because they get inputs from so many functions.<br>• No one makes the breakdown from module level to part level specification → FL has to do it. Not clear whose responsibility it is.<br>• Sometimes the FL has problems and difficulties in specifying the requirements based on the targets. Often SE must go back to the FL to support the reqs specification. (Could depend on the Feature itself) |
| Requirement Specification | FL, SE, Design Eng. | • The requirements stated in the RS from SE cannot store all the requirements because it's too loaded. It's only the totally new ones. Which means that sometimes requirements that already works on the Friday vehicle needs to restate when FL translate the requirements.<br>• SE states some requirements to be "Carry Over" when they aren't. And those "carry overs" are as new requirements in the reality, and needs to be translated again.<br>• When new designers start at VGTT they are not aware about the requirements that work on the Friday vehicle.<br>• The Design Engineer might not be aware of the requirements on the Friday vehicle, which are not listed in the RS which only contains the requirements for the project. → FLs must be policemen to the construction all the time, because the construction doesn't know the Friday vehicle.<br>• Verification req.: Req. That we do not want to change that works today.<br>• Scope creep: When starting the project, setting a scope, during the trip, the scope will change because people changing the scope. (New functions, new concepts).<br>• SE gives only req. which is the new ones. They do not list for a new project the already working |

| | | |
|---|---|---|
| | | requirements on the Friday vehicle (so the designer must know themselves that req. already works), they do not list the carry overs<br>• Often when SE says it is a Carry-over requirement, it is not a carry-over, because the existing requirement position is often changed. |
| | | • WHY is there an RS when all the Req. are not specified?<br>• You have started to learn how it works. From the start it was chaos, now it's better.<br>• The Requirement Mgn is quite complex.<br>• Serena was difficult for FL but good for SE.<br>• Excel is more manageable for FLs since they know Excel, but it is very big and complex. The document is so big it becomes unmanageable for everyone.<br>• It is difficult to get an overall picture of the RS<br>• In one project we recently had an amount of people in the project except the FL decided what requirements was important as overall requirements in the project. Resulted in later that critical overall requirement was not stated. That resulted in when status showed green on the requirements in the RS, critical requirements were red that was not shown towards the project.<br>• RS works well to specify the headlines of the req. but not more on a detailed level. So it is important to be aware about the carry overs.<br>• It is not specified in the RS if there are any balancing performed. |
| Packaging meetings | FL, Design Eng., Packaging | • It should be a better structure on how Packaging, FL and Design should work together.<br>• Packaging should be responsible for balancing. If they get all the inputs from the other requirements, they will see what works and what doesn't work. Instead of that all went to Design and do not know who inputs are specified and who is not. |
| Status | PM | • PM wants everything to be green.<br>• PM notice green colour in the status template but when looking at the detailed level the designer notice red colour at some activities. This is because the PM only looks on a very high level, just the surface of the project. While the designer specifies the status for the detailed activities.  Gives no honest view!!!! |

| | | |
|---|---|---|
| | | • Many people are interested in the status of the feature 'right now', and not the two weeks old status from the FR. It is very disturbing that people contact you all the time regarding the status – no time for actually working!<br><br>• Status should be reported to many different processes and forums, SE and FR, PM, VTC to name some. FR contains status for some main requirements but SE demands status on all requirements, usually a week before the gate parallel to the FR. The contract document does also need to be filled in.<br><br>• SE has only status for SP-start while the FR includes 'right now'-status (gate status).<br><br>• Discussing a lot with PPL if there are red colours.<br><br>• COSP- Complete Offer Solution Provider: There is never a good description about why it (red) doesn't work. Then, when contacting the person saying its red, you get the answer of why it does not work. After you can contact PPL.<br><br>• The updated RS is sent to PMFVV but too late, and then is the status a bit old, so it is no meaning that SE gets that info from PM FVV.<br><br>• It's too much focus on the colours. No one is concerned about solving the actually problem.<br><br>• Can anyone at any time require status as it is today??<br><br>• If we have red colours we must meet architecture to try to solve the problem of red.<br><br>• In one way it's better to use red and green only and not yellow.<br><br>• If FL sets red in a gate, you must either change concept or the goal. req. decision in a forum.<br><br>• If FL sets yellow, you must have a plan for the changes.<br><br>• In the req. Spec. Status Green is often shown for SP-start but there is no status about the current situation on a lower level. So people just think they will manage green at SP-start, but in fact they do not consider fully the current situation and are not actually able to make that statement to set green on SP-start without knowing the exact situation today.<br><br>• The general feeling is that projects are intending to be green even if they should not be green. People set green so everything feels good and alright in the project. The problem is that the issue will pop up |

| | | later in the project, often in the test phase. People do not have respect of what red or green light intend to actually mean.<br>• Status requests in the middle which is not according the process<br>• Continuously status meetings – very time consuming (can maybe be more efficient) |
|---|---|---|
| Got and Lyon – Different ways of working | FL, ALL | • The areas that are included in a feature are different in the different sites. In Gothenburg the feature Comfort & Vibrations includes both engine caused and road caused vibrations, whilst in Lyon it only includes road vibrations and engine vibrations is considered to belong to sound instead. The advantage with the Gothenburg way is that it is easier to see the correlations and hence to make compromises. But on the other hand t results in that the FL is involved in very many projects.<br>• GOT = Water Melon: all green on the outside but red on the inside. Swedish people think a lot, does not follow processes.<br>• In France people discuss a lot and are not so polite = shares their view on other peoples work with them. Less responsible and hence the contracts are necessary. Frenchmen anticipate a lot. |
| PDP | | • The purpose of the PDP is very useful and a good idea. But the use of it is not optimal. It should be a list that shows results and not like a check list like people uses it today.<br>• The RS and the PDP could be grouped like one activity, the overview could be much better. If all the Req. was stated in the RS where status now and status later could be specified they could be grouped.<br>• Is not very suitable for these features, it is made to suit Reliability and Durability and is hence quite meaningless for other features.<br>• The purpose with the PDP is to set the level of the deliverables before each gate. But for x's features it's not effective, because it's difficult to set the deliverables for each gate 4 years ahead. For these features the requirements would be something like that it should takes 34 sec to change one part in the first gate, next deliverables in the next gate should be then write 33 sec. The PDP is quite good. There is no education. |

| | | |
|---|---|---|
| | | • It does not work properly, is more used as verification that certain things has been done. Instead of focusing on the actual results.<br>• Was made too late in a project but should be made much earlier to have the optimal effect.<br>• Often you do not know how much time some activities take and therefore is it challenging to set the PDP<br>• Difficult to set activity methods and result 4 years a head<br>• Do not know who owns the PDP<br>• PDP might be performed earlier, its sent out too late to the FLs<br>• It's more a tool for the manager to check the project |
| Regulations | | • Sometimes regulations have not been included in the RS and therefore they have been missed out in the project. |
| Pre-Feature Review | FL, PPL, PMCV, Project | • Have meetings before the Feature Review meetings to be clear about the status before the actually feature review meeting where the status will be official specified. The feeling is that PPL, PMCV and Project want the red colour boxes to be green colour boxes before the official Feature Review, not good.<br>• Sometimes Pre-Pre Feature Reviews |
| Feature Review | FL | • Everybody is just interested in the colour of the SP-start box. |
| Requirement fulfilment review - RFR | FL, SE | • Before each Gate: New documents needed but specifies the system instead of each feature. |
| Management | ALL | • No change management work in the organization to prevent problems, instead the focus is on solving the problems when they appear. |
| Project | PM | • It would be best if the Project Description was as complete as possible to limit the need of asking questions later on.<br>• How should the feature/Concepts be in the future, writing in to AE , Project Decision Plan. |
| Mind set | ALL | • Focusing to work in order to provide better and improved features. Design Engineer has often |

| | | |
|---|---|---|
| | | opinions about the requirements there is often questioning why the requirements are set. |
| Acceptance of targets | PPL, SE, FL | • The FL gets requirement documentation even if he/she is not affected. The FL must go through the requirements and then state if the project will affect his/hers feature or not |
| TR | Design, FL | • TR makes only if it's supposed |
| Relation with PM | PM, FL | • There is no interaction between FL and PM until the Feature Reviews and then is it often to discuss problems. That is the cause why PM does not have the understanding of certain stated requirements. There is a wish that it should be a better communication and cooperation between FL and PM in the project. Sometimes PM focus too much on construction or when there are problems in the project. |
| Top 3 issues | FL | • States the 3 most important (in a negative perspective) issues in the project. Problem is they do not know who gets them or follow-ups. |
| FMEA | PM, FL | • Are not sure what happens with the FMEA, does someone follow ups the risks. Are not sure who makes what. PM wants to sweep the risks under the carpet.<br>• Some PQM:s do not invite FL's to participate in the FMEA work (Weakness in the process) |
| Protus | | • PM wants to sweep the Protus under the carpet.<br>• All Protus is to be sent to Design. Thereafter FL and Design interacts to solve the Protus contents in order to update the V&V-plan. This interaction can proceed for a long time.<br>• FL is not aware there is a Protus until Design has solutions and then involves the Feature Leader, but FL is not responsible. |
| White Book | | • Lesson Learned: Very good purpose, but where does the White book go, who takes care of it, who takes part of it. It should not only be stated in the end of the project, it should be stated concurrently as the |

| | | |
|---|---|---|
| | | project proceed. (Because the project is so long).<br>• Doesn't work properly because we it is not followed up correctly as it should. "-Who will ever read what I have been written in the White book"?<br>• What happens with the White book?? |
| FLGOT | | • Everyone does not get the chance to speak out due to that some people speaks a lot and takes over the session.<br>• Sometimes it's very high level issues that is discussed and its then difficult to fallow the discussion<br>• There is no protocol written of what is actually discussed and decided at the meetings, not what I am aware about |
| Official Forum | | • Missing an official Forum where activities or tasks can be stated which not are fulfilled. |
| V&V Plan | PMFVV, FL | • PM is supposed to gather all the V&V plans from the FLs which often takes a lot of time.<br>• To update the V&V plans often takes a lot of time, the V&V plan is complicated<br>• What are stated in the V&V plan is often difficult to manage in a time perspective. Sometimes the planned time can pass several weeks<br>• Today the FLs are not so involved in the upstream part of the V&V-plan → problems in the down-stream part and no follow ups.<br>• Needs to have people trained on the technical part.<br>• Difficult to set a budget for something that will be done in four years from now and also difficult to plan when production will start for a certain module.<br>• Often problems when planning what to test in resources and time perspective due to that often tests need to be redone and if you have not planned for that it gets really difficult to find new time and vehicle to test.<br>• The design loops are not considered in the tests – it must be better margins<br>• Plans are never hold. People have to re-plan all the time.<br>• Before knowing how many tests is needed the test trucks is planned in to the project. Which means that later on there is often not enough vehicles to test on |

| | | |
|---|---|---|
| | | • or many tests conflicts.<br>• For some FL this is very time consuming, because they need to puzzle around the schedule. |
| AE/<br>Competitor<br>Status | FL, Project | • Often the project does not want to pay for competitor test/analysis, they think we should have the knowledge about the competitors anyway<br>• The competitor Analysis could be much better, because it's very important to know what the customers wants, the clinics correspond to what the customer wants.<br>• The competitive set in the status template should be removed, because the project starts based on the status for a specific moment<br>• Rarely happens due to too little resources/limited budget and very expensive test<br>• Too little resources/time for AE<br>• AE should be between the projects and not within the projects<br>• Are not always done due to resources<br>• The competitor Analysis could be much better, because it's very important to know what the customers want, the clinics correspond to what the customer wants. |
| Simulation | FL, PPL | • Sometimes the simulations do not correspond to the physical tests. PPL uses the physical tests only as verification → when they do not correspond to the simulations there is no time scheduled for fixing the problems → task force. Solution: better simulations with confidence / tests made earlier. |
| Time frame | FL, Design | • Design does not consider the recommendations since it is not announced in the time frame →FDCG is often delayed.<br>• The critical part for the feature is not respected.<br>• Late deliveries.<br>• A lot of time is spent on hunting trucks.<br>• Many time you have to re-do tests to get proper results.<br>• C-release is made too late / FDCG is opened even if no C-release<br>• Do not have enough time to evaluate the risks of the concept. They need more resources in the beginning of the projects, because the concepts are too risky.<br>• There is not enough time to evaluate the risks of the |

| | | |
|---|---|---|
| | | concept. There need to be more resources in the beginning of the project because it is a very risky moment |
| Design Review | | • The Design Reviews is not really happens in the most properly way, all functions should participate to make it optimal but they don't. |
| Introduction | Organization | • There should be better introduction and training material when new methods and models are supposed to be integrated in the organization.<br>• No introduction to the work<br>• No assigned person to ask questions to<br>• No introduction to the training material<br>• No introduction of who is in the network in order to perform the work tasks<br>• Back in time when new employees started to work they went along another employee to learn the work quicker. |
| Interaction with Engineering | | • FL must sometimes act as policemen.<br>• Some activities that are obvious to do is not done by Design- FL must always push and be alert in order to be ensure Design makes the task<br>• It would be good if the FLs were more committed in the construction since they are the responsible alt. that they delegate the responsibility to break down requirements to detailed level to Construction/Design.<br>• Today the FLs are not so involved in the upstream part of the V&V-plan → problems in the down-stream part and no follow ups.<br>• Needs to have people trained on the technical part.<br>• What are stated in the V&V plan is often difficult to manage in a time perspective. Sometimes the planned time can pass several weeks<br>• To update the V&V plans often takes a lot of time, the V&V plan is complicated |
| Abbreviations | | • It is difficult to remember all the abbreviations and what they stands for |
| Pre Req. | | • According to PPL PD want to freeze the pre-requisites too early. It would be better if the pre-requisites were frozen at CG. |

| | | • Usually people do not read the pre-reqs. |
|---|---|---|
| Technical spec. | | • In reality the technical specification is no taken into account. |
| Cost vs. quality | | • Cost is often more prioritized at Volvo GTT than quality, unfortunately. |
| No respect to the GDP | | • Overall the GDP is fallowed, but what makes the work difficult is that PM makes up their own process within the GDP. If I am working in 6 different projects I have 6 new differently internal processes to fallow for each project, very confusing and annoying. |
| Project participants location | | • Project participants are spread out over the organization which results in poor communication and lacking in the how the functions are synchronized.<br>• It was a bad choice when the FLs were moved from Engineering to their own group |
| Launched tools | | • Today is the tools in the project launched too early |
| Regulations | | • Sometimes regulations have not been included in the RS and therefore they have been missed out in the project. |
| High workload | FL | • Sometimes the FL has so high workload and they must delegate the work to another. The problem is that the FL is a specialist so it's difficult to delegate work to someone else. |
| Not enough contact | FL, SE | • FL and SE should have more close contact. |
| Do not have the fully project view | FL | • FL do not have the view of what the SE functions are actually doing, how much work they spent on the req. how much time they spent on contacting people not delivering document in time.<br>• Different functions in a project do not have the correct view of what other functions are actually performing in a project<br>• Involved participants in a project have different views of where the project actually is in time and task perspective |

| Traffic Light | | • People does not fallow the traffic light system<br>• It is not clear how to work and use the traffic light<br>• Not so clear when you are new as a Feature Leader. SP-start reporting is non-value adding since everything has to be green prior to SP-start. However it is interesting to have a forecast, but maybe it is enough to have it for next gate? For CSG it is very difficult to forecast SP-start status since you even do not know the scope of the project / the requirements and pre-requisites are not set/frozen. |
|---|---|---|
| FLs are not respected | | • Engineering stating their own requirements because they think they formulate the requirements in a more qualitative way than FLs.<br>• Who's side should FL stand on; the project or the customer? |
| Processes | | • There are many processes but no one uses<br>• The FL gets the Requirement doc. Even if he/she is not affected. The FL must go through the requirements and then state if the project will affect his/hers feature or not<br>• Different projects have different internal processes<br>• There is no structured way of how to set the module requirements<br>• When FL setting the colours of the status they are about to make the judgment of the project status how far Eng. Are from a solution without interacting engineering. Can't be optimal. |
| SE-process | | • SE process does not always match the reality, it is too complicated to write measurable requirements on CO level<br>• SE expects FL to deliver more than they do |
| Training material | | • Not clear who is responsible for supporting new FL´s/who should educate<br>• PM´s have little education in the FL´s work and does not fallow the GDI<br>• Difficult to find the material training material on Team Place.<br>• No read thread in the training material format<br>• Too little practical examples<br>• More distinct descriptions is needed |

| | | |
|---|---|---|
| Mistrust | | • The FL must trust the test engineers more in their work, let them feel responsible |
| Lack in information to the test engineers<br><br>Test engineers are not fully informed and *Additional comments from test engineers* | | • Test engineers just get information about what to do and do not get information of why they are supposed to do the test.<br>• Do not get the information needed to perform the work.<br>• Work that the test engineers performs are never evaluated<br>• Gets not invited to upstart meetings and are therefore not aware what will happen next in the project<br>• There is no continuously educations<br>• There is no feedback of what you do<br>• There is no plan when starting as a new employee<br>• A lot of double work because FL is all the time double checking what has been done.<br>• People do not trust each other<br>• |
| Lack in informing FLcab | PMcab, FLcab | • FL on Cab and El commodity are not so informed about different things concerning their work, such as what is the SE-process, what requirements and balancing are. This depends on that PMCab have so much engineering work to think of and have no time for feature activities while the PMCV have no deliveries to make and hence have more time for informing the Feature Leaders. |
| Sign off | | Different definitions of sign off: Pre-reqs sign off is when PPL informs the project about which the pre.-reqs. Are. PPL does not inform stakeholders that the pre.-reqs. only are the wishes and that it isn't guaranteed that they will be delivered in the end. This causes conflicts when the stakeholders take part in the FDCG (the contract) and they realize that their wishes aren't fulfilled. This leads to a lot of extra work!<br>The communication of what pre.-reqs. Vs. requirements and balancing are is bad.<br><br>• There is hence a major difference between SE balancing/release and PPL sign off! |

| | | |
|---|---|---|
| Designing concepts too early | Design, PM | • Design starts developing concepts before FL have given their inputs.<br>• It is very important that the FL inputs are given early in the project so that Design knows what requirements to follow before they start their work and to avoid time waste in the beginning of the project.<br>• It is a problem that the requirements are established before "we" know what to develop, because PD is too slow.<br>• Concepts should be more detailed in CG-DG. Because there is a lot of rework and bugs in the later phases (C1, C2, C3) |
| Tasks force | | • Too many task force due to that the project spend too little time in the beginning of the project<br>• In P2683 many task forces due to too little time spent on the upstream activities and on how the breakdown works. |
| Knowledge | | • The competence around the organization is in some areas lacking, the technical skills are sometimes poor<br>• Since there have been an increased use of consultants the last 10-20 years and a lot of changing in the staff, the loss of competence has increased. |
| Change Management | | • There is no work of Change Management to prevent problems, instead the focus is on solving the problems when they appear |
| Sometimes confusing between Gates and A,B,C-releases | Project | • The Gates are for the administration of the project. But the important event happens before a Release (A, B, C). It's before the Releases the big changes happen, it happens nothing regarding the products before the Gate-opening. |
| Look for people | | • A lot of time is put on looking and phoning people to get right information. |
| Administration | ALL | • A lot of administration, bureaucracy, you must have permission for everything nowadays.<br>• A lot of administration of very unnecessary activities. |
| Individuals | | • Many factors of issues are based on peoples |

| personality | | personalities, how much people like each other. |
|---|---|---|
| Development Loops | | • The Development Loops are not synchronized with the gates |
| Protus | | • Often very stressful to close the Protus and sometimes it's done without a proper motivation<br>• Too little information in the Protus |
| Engineering points of view | | • FL should have more responsibility, be more committed to the engineers work, be part of establishing technical solutions and technical requirements.<br>• Sometimes Eng., walks around a specific person because they have bad history with a specific person, it's very person-dependent.<br>• FLs have not the competence needed in some areas, Eng. has that knowledge instead, and sometimes Eng. takes more responsibility than their authority.<br>• When projects run well, Eng. Is not responsibly but when projects run bad, Eng. Are responsible.<br>• There is a feeling that Eng. Do not take fully responsibility for their tasks |
| Software issues | | • Some people think that Software is very "easy" to update and change because the attitude is "Its only Software".... |

# Appendix G: Identified waste

| Waste | Identified areas |
|---|---|
| Waiting | • Poor communication<br>• Uninformed<br>• Status reporting<br>• V&V plan<br>• Look for people |
| Inventory | • Unnecessary Email<br>• Team place<br>• RS<br>• PDP<br>• Requirement fulfilment review<br>• Acceptance of targets<br>• FLGOT<br>• Pre Requisites<br>• Technical specification<br>• Poor processes<br>• Training material<br>• Role position<br>• Knowledge<br>• Confusing information between Gates and A,B,C releases |
| Excessive processing | • Pre-pre Feature Review<br>• Status reporting<br>• Feature Review<br>• Acceptance of targets<br>• Top 3 issues<br>• FMEA<br>• White book<br>• Interaction with Engineering<br>• FLs work is not respected<br>• Knowledge |
| Transportation | • Poor communication<br>• Uninformed<br>• RS<br>• Status reporting |

| | |
|---|---|
| | • Protus<br>• White book<br>• Time frame<br>• Difficulties setting the Req.<br>• No project view<br>• Sign off |
| Unnecessary motion | • Uninformed<br>• Status reporting<br>• Different ways of working (GOT-Lyon)<br>• TR<br>• Poor relation with PM<br>• Official forum<br>• Cultural differences<br>• Simulation<br>• Task forces<br>• Design review<br>• Interaction with Engineering<br>• No respect to the GPD<br>• Location of the project participants<br>• Difficulties setting the Req.<br>• No project view<br>• Traffic light<br>• FLs work is not respected<br>• Poor processes<br>• Lack in informing FL Cab and El commodities<br>• Development starts too early<br>• Look for people<br>• Re-plan<br>• Development loops |
| Overproduction | • Administration<br>• Acceptance of targets<br>• Launched tools |
| Defects | • Balancing<br>• Risk List<br>• Uninformed<br>• Test planning<br>• Breaking down req.<br>• RS<br>• Packaging meetings<br>• PM sees green in the status report, |

| | |
|---|---|
| | <ul><li>the actual colour are red</li><li>PDP</li><li>Regulations</li><li>Carry overs</li><li>Change Management</li><li>The mind set</li><li>V&V plan</li><li>Simulation</li><li>Abbreviations</li><li>Cost vs. quality</li><li>Designing concepts too early</li><li>Knowledge</li><li>Software issues</li><li>Concepts are too vague</li></ul> |
| rework | <ul><li>Poor communication</li><li>Uninformed</li><li>RS</li><li>Test planning</li><li>PM sees green in the status report, the actual colour are red</li><li>Status reporting</li><li>Carry overs</li><li>Change Management</li><li>Project description</li><li>AE/Competitor status</li><li>Time frame</li><li>Introduction to new methods</li><li>Do not have enough time</li><li>Abbreviations</li><li>Cost vs. quality</li><li>Introduction to new Feature Leaders</li><li>Knowledge</li><li>Individuals personality</li><li>Concepts are too vague</li></ul> |
| Storage | <ul><li>Status reporting</li><li>High workload</li></ul> |
| Unused creativity | <ul><li>Poor communication</li><li>Uninformed</li><li>RS</li><li>Status reporting</li><li>Project Decision plan</li><li>The mind set</li></ul> |

|  | • V&V plan<br>• Introduction to new Feature Leaders<br>• Lack in information to the test engineers |
|---|---|

| Waste | Frequency | % |
|---|---|---|
| Waiting | 5 | 0,04 |
| Inventory | 14 | 0,12 |
| Excessive processing | 10 | 0,086 |
| Transportation | 10 | 0,086 |
| Unnecessary motion | 23 | 0,198 |
| Overproduction | 3 | 0,025 |
| Defects | 21 | 0,18 |
| rework | 19 | 0,16 |
| Storage | 2 | 0,017 |
| Unused creativity | 9 | 0,077 |
| Total: | 116 | |

## Appendix H: Suggested Final Agreement Template

| Date: |
|---|

### Final Agreement Template

**Feature name:**

**Project:**

**Brand:**

**INPUT:**

The input of this Final Agreement document is from the last issue

Feature Status Template:

| Nr: XXXYYY |
|---|

which is attached this document, appendix: XXXYYX

**Special attention requirements:**

Requirements that are considered needing special attention in order to reach the agreed level are specified:

|  |
|  |
|  |
|  |
|  |

**Requirements:**

The agreed sub features and /or requirements of this project regarding this feature are stated in the Requirement Specification (SE).

RS: Issue XXXYX

All relevant information considering the requirements is given in that document and acts as the agreement of what will be delivered.

2/2

**Final Agreement committed by:**

| | Sign: | Comments: |

LXXII

| |
|---|
| FL/GPFL |
| CPM |
| PPL/Brand |
| PDPM |
| PMFVV |
| Appendices: |
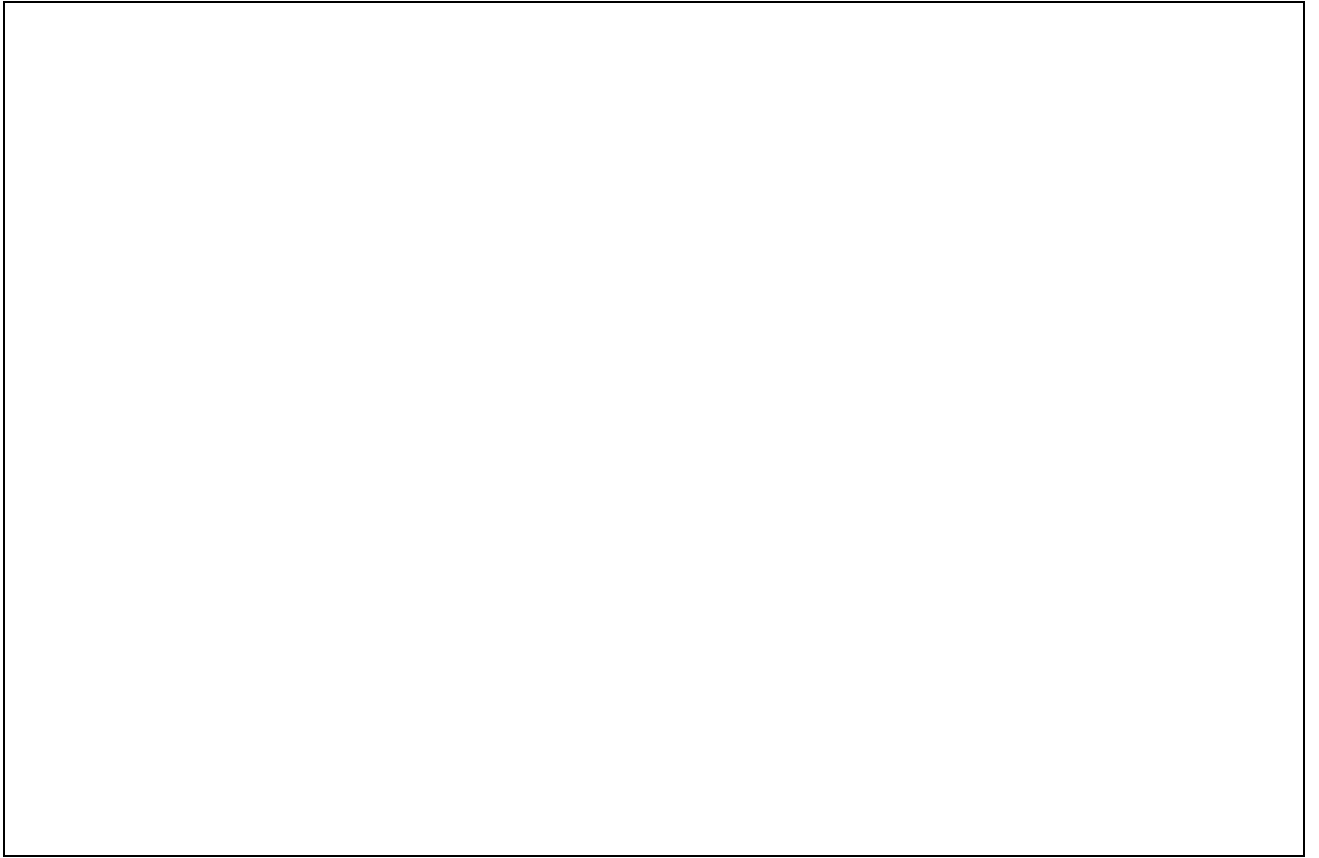
# Appendix I: Final Agreement Instruction

# Final Agreement Instruction

---

## Orientation

The Final Agreement signing instruction is a document that describes the procedure and the involved activities that needs to be performed when signing the Final Agreement document at FDCG in projects.

## Ownership

This instruction is owned by Volvo Group Trucks Technology and if necessary for further clarification of this instruction, please do contact responsible: _____

The Final Agreement signing procedure is performed by the Feature Leader who has the responsibility to fill in the Final Agreement document and send it to the Final Agreement map on the intranet team place xxx.

## Scope

This instruction aims to visualize the process procedure when signing the Final Agreement and the different steps it contains. It will present the function, purpose and the use of the Final agreement in projects.

## Application

The Final Agreement instruction is mainly directed to the Feature Leader, CPM, PPL/Brand, PDPM and PMFVV. However, the Final Agreement content is crucial to be directed to all functions and roles that acts in a project in order for all involved parts to be informed about the final agreement of what will be delivered to the end customers.

## Purpose of the Final Agreement signing

The aim with the Final Agreement document is to act as the agreement of what will be delivered to the end customer. It will visualize the actual level of performance provided in proportion to the initially wanted performance. The Requirement Specification acts as the base for the Final Agreement and is the document the signers agreed upon. The project members will be informed regarding the agreement of what will be delivered and use it as a foundation document when continue working.

**Objective**

The origin requirements as well as the requirements that have not been fulfilled during the project and have been balanced or rejected) will in this Final Agreement be agreed and signed by the stakeholders and functions committed to this agreement.

**The Final Agreement signing procedure**

The procedure of the Final Agreement signing can be illustrated in Figure N1. It visualizes the different steps of how to fill in the document.
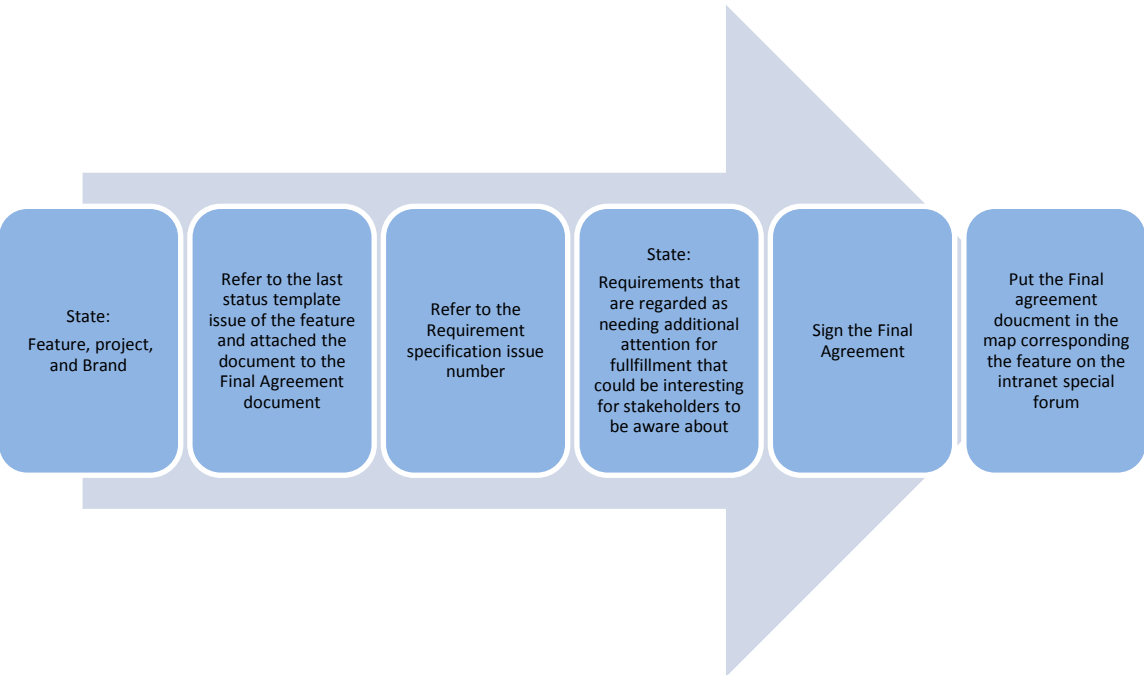


**Figure N1:** The Final Agreement signing procedure.

# Appendix J: Instruction for Visual Planning & Improvement Board

**Visual Planning**

| | |
|---|---|
| **Stating the activities to be performed the comming week on sticky** | • Before the meeting the different roles state down the main activities he/she is about to perform during the coming week on sticky notes.<br>• Activities he/she knows they will perform the coming next 2 weeks and the next month are stated on sticky notes. |
| **Stand-up meeting** | • Once a day or every other day (preferably in the morning) the team meets for a stand up meeting for 10 minutes only, no more no less. |
| **Stating the sticky on the board** | • One person at a time place out the activities he/she has earlier stated on sticky notes on the corresponding day, week and moth they are about the performed.<br>• The person can express some short description of the activities he/she will do as a summary, but not to in detail. |
| **Additional information** | • The person putting the activities sticky notes on the board should also state if activities that were planned to be performed and are already stated on the board will be delayed.<br>• With a corresponding colour that indicated delay are place and also the reason for the delay reason. |
| **Discussion** | • During or after the different persons have stated their activities on the board other people are welcome to interpose with comments. |

**Improvement Board**

**Identification and Preperation of issue statement**

- The Feature Leader comes up with a problem related issue (could be absolutely anything, from curtains, layout of desks to process instructions, procedures layouts or eduaction).
- The issue is stated on a sticky sticky note.
- The Feature Leader needs to have some type of settlement proposal regarding the issue stated from the start.

**Stand up meeting**

- Preferably once a week the Feature Leader group meets, the meetings should be frequently and last for around 15 minutes maximum.
- A Lean mentor holds the meetings and are responsible for its execution.

**Reviewing each issue**

- Every statement are described by the owner of the statementat to the others in the group (Feature Leader), one by one with no interruption.

**Determine location of benefits vs. costs**

- After that each statement been declared the group discuss together where the issue should be located in perspective of benifit vs. costs on the pickchart.
- The group makes the decision where to place it togehter in lead of the Lean manager.

**Propose solutions**

- Action plan is stated, made by the Lean Manager.

**Determine responsible solution executer**

- Action performer and responsible are selected and date for execution is settle.