MÄLARDALENS HÖGSKOLA
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School of Innovation, Design and Engineering

Reduction of average project lead time

(Volvo Construction Equipment AB - Case Study)

Master Thesis Work, Concurrent Engineering

30 HCP, Advanced level

Concurrent Engineering

Master Product Development

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Presentation date: 20 January 2014

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Abstract/Summary

Date: 2014-01-20

Level: Master thesis in Product and process development

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Title: Reduce average project lead time
Volvo Construction Equipment AB - Case Study

Tutor: Sten Grahn

Problem: Reduce average project lead time while keeping control on quality and cost

Purpose: Find recommendations to reduce Product Development project lead time.

Delimitation : Project Office, Sweden – Projects Wheel Loaders models L60F-L350F

Method: Case study on Volvo CE. Qualitative studies concluding in a theoretical framework tested against empirical findings.

Conclusion: Looking at the company strategy, knowledge and organization, Volvo CE needs to take improvement actions within knowledge and organization to reduce the product development project lead time.

Keywords: *Volvo Construction Equipment, product development, lead-time*

Preface

This Master thesis in Product Development has been conducted at Mälardalen University under the department of Innovation, Design and Engineering.

We would like express our gratitude to Volvo CE and the colleagues in our organisation that has taken the time to support us and raised inputs needed in our progressing work. We would also like to thank our supervisor Sten Grahn for the support during the writing of this thesis.

The thesis has given us deeper understanding of the different faces in the R&D process and the complications and deadlines that are surrounding the development of new Volvo CE products. We hope that we have contributed to the continuous improvements with the R&D department of Volvo CE, Sweden. We know for a fact that this will be valuable for ourselves as we progress in our career.

Sweden has a long history of technical innovation and Swedes are well known for their discipline, knowledge and technical quality. As a consequence there is no surprise that Sweden has a number of international companies that are considered to be on top of their respective field such as Ericsson, Sandvik, IKEA and Scania. To be able to reach that level it is crucial to have the products needed, and as a result a high budget is spent on the R&D departments.

Our background being Volvo Construction Equipment AB (Volvo CE) employees with a combined industry experience of 20 years. We currently hold the positions of Area Customer Support Manager and Customer Finance Manager but with background from R&D.

The construction industry is very aggressive not only to price products correctly but also the performance and adapting to rules and regulations worldwide. This has raised concern in our R&D departments and the obstacles they face on a day to day basis to fulfil all the requirements that confronts them. The aim is to find bottlenecks and room for improvements in the existing work structure at Volvo CE.

Table of Content

1. Introduction

This chapter describes the background on the chosen topic and illuminates the problem that will be further explained.

1.1 Background

There is still an on-going debate amongst researchers, where one side emphasises the strategic importance of cost management in highly competitive markets; others address the importance of time-based competition, putting focus on reducing the product development processes. (Everaert & Bruggeman, 2002)

Time, cost and quality have always been the factors that companies face in order to meet the markets demands towards perfection. Companies have lately seen how the product development or "time-to-market" has been the single most important factor to stay on edge and keep advantage over its competitors. The increasing speed of innovation must not neglect the focus on reducing development cycles. From early 80's to 2006 the automotive industry has reduced the production development process by a third to 24 months. (Hoppmann et. Al, 2011, p. 3: Mallick & Schroed, 2005, p. 142: Khazanet, 1997, p. 16: Meybodi, 2003, p.117).

The impact on cost, quality and manufacturing lead–times are set in the early production development phase rather than the production stages later on. (Hoppmann et. Al, 2011, p. 3)

In light of the increasing competitiveness there is a need for further research in the field of product development to find project improvements (Antoni et. Al 2005, p. 876, 890)

As Katz S (et al 2005, p.48) so clearly describes being "late" in product development usually means two things:

- Late in relation to competition!
- Late in relation to market window/technology availability!

1.2 Problem background at Volvo CE

"The intensified competition has shown that competitors are launching products much quicker than before and with reduced average lead times. To remain as a competitive player in the industry, Volvo CE must remain efficient and ensure time is well spent in our ongoing product development projects". (Carldén, Project Management Engineer, 2012)

Volvo Construction Equipment AB is one of the largest manufacturers of construction equipment and a business area of AB Volvo. Volvo CE is covering a wide range of industry segments from roads to quarries, and the largest manufacturer of articulated haulers and wheel loaders, with a great heritage of engineering excellence. Volvo CE's core philosophy of quality, safety and environmental care should fit into its design, development and delivery to its customers. (www.volvo.com[1])

Global Development process, GDP is a global process used within AB Volvo for the development of new commercial products. The GDP has been created to simplify the cooperation and communication between different sections of Volvo organizations and companies around the globe. The GDP is intended to provide a standardized way to execute new product development projects within AB Volvo.

The increased focus on product development projects lead-time, emphasize the need to examine the Global Development Process at Volvo Construction Equipment.

1.3 Research Questions

Question 1: How can the lead time in product development projects be reduced while keeping control on quality and cost?

Question 2: Is knowledge from earlier projects at VCE transferred to future projects? If so, how is it being done?

1.4 Disposition

Chapter 1, Will give an introduction to the problem background at Volvo CE, and reasons as to why this problem needs further research.

Chapter 2-4, Set the purpose and objectives for this thesis as well as the directives that have been given from Volvo CE.

Chapter 5, Describes the solution Method from start to end, including the conceptual model. It also informs the reader on why certain topics have just been touched upon and why certain parts are more in depth. The chapter then finishes based around effects to the end result based on the theories used.

Chapter 6, Shows the empirical raw data extracted from Volvo through printed material and interviews, and provides the reader with a clear view on the current status at Volvo CE.

Chapter 7, Provides the reader with the theoretical foundation that questionnaire and conceptual model will be based upon.

Chapter 8, Results are presented and further dissected in the analysis section, where empirical data from chapter 8 are analyzed against the theoretical finding presented in chapter 6. This will show if Volvo CE results are aligned according to earlier scholar's studies.

Chapter 9, Provides the result of the findings in these thesis.

Chapter 10, Reflection around interviews made, recommendation on further studies as well as the implementation of improvement actions.

Chapter 11, Concludes with recommendations and management implications and also limitations in our result published in this thesis.

Chapter 12-13, List of references used, and the appendix list.

2. Purpose and Objectives

The purpose of this study is to find areas of improvement which will lead to reduce project lead time in the product development process at Volvo Construction Equipment (VCE), without compromising on quality or cost.

The objectives of this thesis are to;

- Investigate if the strategy at Volvo CE is in alignment with reduction of project lead time. Present at least one improvement action.
- Investigate if the organisation is right sized and efficient in order to reduce project lead time. Present at least one improvement action.
- Investigate if the knowledge sharing with Volvo CE is ideal for reducing project lead time. Present at least one improvement action.

3. Project Directive

A non-disclosure agreement is established between Volvo CE and the students, to not reveal any information until approved by the supervisor of Volvo CE.

The thesis will be documented in English as it is the corporate language of Volvo CE organisation.

The expected result should be made available for Volvo CE no later than end of 2013.

Result will be reviewed and approved by Volvo CE before made being available for public use.

The given time frame for this thesis is limited to 20 working weeks and will be conducted out of our ordinary work task, except interviews which are schedule during working hours.

4 Project Delimitations

Volvo CE project development teams are spread out all over the world; however two of the main products within Volvo CE (Haulers and Loaders) are developed in the R&D center in Eskilstuna and Braås. We have limited our study to project office in Eskilstuna, Sweden which believes to be representative for the rest of Volvo CE.

Due to the long product development lead times for complete machines the thesis will not be able to provide any data that shows that the recommendation reduces actual lead time. In chapter 8 analysis, the thesis is going to support why recommendations made are important for future progress in reducing lead time.

The study will handle the three important areas of Volvo CE, Strategy, organization and knowledge in correlation with cost, quality and time.

Resources with relevant competence for interviews and consulting will be recommended through our supervisor and interview candidates at Volvo CE. Out of practical reasons all relevant stakeholders to be interviewed will be chosen from Eskilstuna office.

The given time frame for this thesis is limited to 20 working weeks. This limits the study to only be based on gathered information from different experienced stakeholders.

5. Solution Method

This chapter presents the research methodology of the master thesis, why these methods have been chosen and the advantages or disadvantage the methods might have to the findings. The aim is that the reader should access the validity and reliability of the end result.

5.1 Planning and start up

The Thesis started with a meeting with Erik Carldén to get an understanding of the background problem for Volvo CE and the organization Volvo has in place for product development.

5.2 Research and theoretical disposition

After the first meeting with our supervisor Erik Carldén, project management engineer at project office in Volvo CE Eskilstuna, where the problem was discussed we made a plan to do a systematic review of gathered literature to retrieve a deeper understanding in the field of product development and what needs further research.

In the early stages after the first discussions with Volvo it was clear that the factors of Cost and Quality could not be neglected as it would have a direct correlation against the time spent, and needed to be included into the scope.

Following areas were decided to be studied further:

- The main time-to-market strategies, with focus on lead times. This will provide the reader with a quick overview on the most used strategies. In addition to time-to-market strategies, a few selective strategies with focus on lead time will be touched upon briefly.
- Product development phases at an early stage need further examinations, since a solid ground work in the early stages will prevent late amendments that affect the overall lead times.
- It is well known that in the automotive industry Toyota has long been referred to as an excellent manufacturer with top quality, therefore the Lean philosophy will be briefly touched upon, despite it being mainly used on the production line.

5.3 Conceptual framework

In the early discussions with our supervisor at Volvo CE, cost, time and quality were highlighted and considered to be the most significant factors when dealing with product development and manufacturing. All three factors interact with each other and as a consequence they all should have the same importance from a management perspective. In order not to offset any of these factors, we found it important to create a visual model to stress the importance on how these areas are to be interacted. There should also be a cross functional collaboration against the factors and also the important areas of Volvo CE where they can affect these factors in a positive way. Based on the early interview and discussions with our supervisor we found three important areas within Volvo CE that we have chosen to analyze: Strategy, Organization and Knowledge. The decision was taken based on the size of the potential of improvement and the lack of earlier researches in these three areas.
These have been included as layers in our visual model. Each layer added should put a positive effect to the triangle to minimize the factors (e.g reduced cost, reduced time, minimize quality defects)

Our model shows these three factors C (cost), Q (quality) and T (time), together with our layers, Strategy, Organization, and Knowledge.

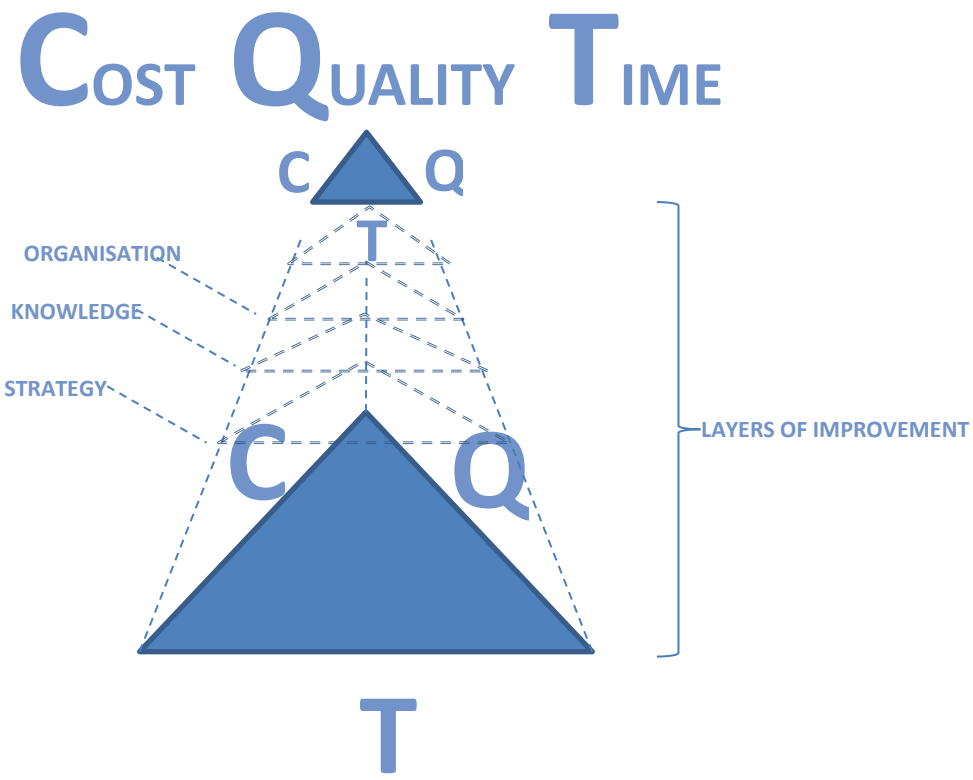

Figure 2 (own model)

C (cost) needs to minimize in our model in order to keep cost in control.
Q (quality) needs to minimize in our model in order to keep quality errors on a minimum.
T (time) needs to minimize in our model in order to secure that deadlines and gates are meet.

The model shows parameters as different layers that all contributes into keeping our three factor relations intact, but with a slight improvement (e.g. smaller Triangle is the wanted position).

Our conclusions and recommendation will be based on the areas of improvement which we find as a result of the interviews which will be held with relevant people in Volvo CE Eskilstuna organization. We will divide our questionnaire (Appendix D) into these three areas mentioned above, and from the theory used create relevant questions to find out if the Development Process at Volvo CE incorporates all these areas with equal importance.

5.4 Qualitative method – case study

One of the most important sources of information for the case studies is the interviews. The main source of data collected in this research is based on interviews mainly with project managers and other relevant stakeholders.

A qualitative method will be used in this case study at Volvo. The reason is to single out key persons with deep knowledge and interest in the subject. The supervisor at Volvo CE will select the first key persons for interview. The aim is to provide results based on expertise and genuine interest in product development and the factors that surround it.

5.5 Questionnaires

The questionnaire for the interviewers (Appendix D) will be developed after the literature study and collecting the data after the first discussions with our Supervisor. This will be shown in a first column with the author's name, second column for the keyword collected from that literature, and a third column will show the questions created, based on selected keywords. Furthermore questions will be developed and categorized as per the layers we found important in our theoretical model shown under heading 7.3

5.6 Interview candidates

The candidates will be selected based on a snowball sampling effect where respondents were asked to provide suitable candidates that could be added to the empirical data collection. Since we did not know which person's experiences are relevant to our studies we needed to be directed through our supervisor and the interview candidates. The risk is that the interview group could be a group of friends instead of the relevant employers. However we do not believe we would be able to make a better selection ourselves.

Prior to the interviews, all candidates will be informed about the purpose of the interview. The aim is to have an open dialogue in order to get the respondent to feel comfortable with the interview and questions enabling the information to be freely expressed. Furthermore questions will be presented in an open-ended way to have the respondent elaborate the answer and possibly provide new leads or new follow up questions.

Respondent result will be compiled, summarized and returned to the respondents for approval before it is used in the thesis.

5.7 Snow boll sampling

Snow boll sampling is defined as a non-probability sampling technique which used for gathering research data. This technique is used to identify subjects which are hard to locate. This type of sampling technique works like chain referral. The process in the snow boll sampling is starts with asking the main subject to nominate other subject (person) with the same area. The researchers continue to do the same thing until a sufficient number of subjects have been reached.

Snowball sampling takes advantage of the social networks of identified respondents, which can be used to provide a researcher with an escalating set of potential contacts with the right experience.

5.8 Direct observation

Some data will be collected through direct observation which can be in different forms, both during formal and casual activities. Formal activities such as meetings with our supervisor or other stakeholders or informal discussions with some of the people we met during our visit to Eskilstuna office. These observations were not performed according to any certain process, but rather in an informative session or ad hock discussions to obtain a better insight into the project management in the R&D department and their practices.

5.9 Validity and Reliability

Since we are studying the project office in Eskilstuna we are limited in our results to conclude a general rule for the Volvo CE business, however since both the hauler and wheel loader products, two main products within Volvo CE, have the R&D located in Eskilstuna we are confident that our conclusions will be of use for the rest of Volvo CE regions.

There is a risk that factors affecting a product development process might be left out when not going into depth on different theoretical strategies. However as researchers have showed it is important to use a mix of different strategies. As there is a deadline set in this thesis, the target has been to collect the most used strategies and by that the ending recommendation will enlighten certain strategies that need more attention or more understanding around these.

5.10 Further studies

To study this subject deeper and reach more accurate result based on own experience and less on others input we recommend doing a longer study on a PhD level which gives the possibility to follow certain chosen projects in present time. This kind of study will not only provide accurate information, but also will easily identify potential areas of improvement to cut project lead time. In the same time a PhD study would provide enough time to both observe and measure the different activities within a project.

6. Product development process at VCE

This chapter presents the empirical data found in printed material and during interviews. The purpose with this chapter is to describe the current Global Development Process at Volvo CE, project office in Eskilstuna. This chapter will also raise the awareness of those challenges Volvo CE face in terms of strategy, organization and the knowledge within the organization.

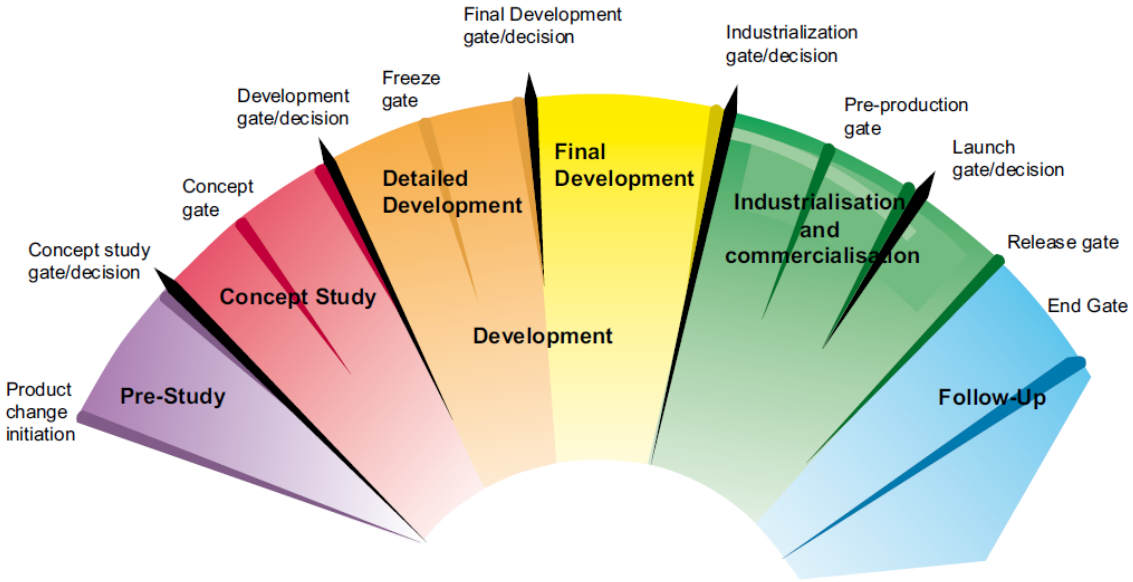

Figure 3 – Global Development Process, Volvo Construction Equipment GDP Booklet

6.1 Global development process, GDP

The Global Development process, GDP is a global process used with in AB Volvo for the development of new commercial products. The tool is used both for medium and large size projects where the project cost can be up to 300 Million SEK. The GDP includes the required inputs, activities to perform, methods to use, as well as deliverables. The pictured figure above is a simple description of the GDP process.

Product Development projects are divided into three sizes/scope classes. Each class is managed differently due to the size of the start cost and the investment. The project class recommends a set of gates and decision points for the project to pass. New products or major changes to existing products which are normally the biggest and most costly projects, the budget of this can be up to 300 million SEK and are placed in the 3rd category.

The 2nd category includes modifications made to existing products. Normally the budget is smaller in this class and the project time shorter.

The 1st category includes very small projects such as creations of new options using mostly existing parts.

The GDP has been created to simplify the cooperation and communication between different part of Volvo organizations and companies around the globe. With the help of the model above Volvo can use the same phases and gates for all project setups. For the project handling as such, the GDP contains descriptions for how different projects can be organized, steered and handled with project management tools.
Generally the different phases of the GDP generate the output data for the next phase or the one after. The input data becomes the foundation of the work of current phase. The work is performed according to the guiding principles for the current phase. To guarantee that the partial result of a phase is reached a gate has to be passed inside a phase. In the end of each phase there also a gate to pass, this is also to ensure that the expected result has been reached. Whenever a phase is completed with the expected result in hand, there is a decision making point in connection with it, here the decision to continue into next phase is taken.
A steering committee approves gate criteria and gate opening based on material provided by the Chief Project Manager and supports the project team as required. The Steering Committee also approves the Project Management team, including the Chief Project Manager, and their responsibilities and areas of authority.

6.1.1 The phases

Pre-study: During this phase the scope of the project is defined by establishing project conditions (goals, directives, target description and prerequisites), developing requirements and alternative solution concepts.
Concept study: Analyze all concepts and select one for development. In this phase the project prerequisites are frozen and the project description signed.
Detailed development: The solutions are both to be defined and approved in this phase. The project descriptions are also frozen and signed.
Final verification: In this phase the product solution is build, verify, validated and refined. Also the Market, Aftermarket, Manufacturing and Assembly solutions are refined.
Industrialization and commercialization: The industrialization system is installed, prepared and verified. As well as the product and the Aftermarket products are launched. Sign the Product Release approval.
Follow up: In this phase the project is handed over to the line organization. The project target fulfillment is followed up, the experience summarized and at last the project is closed.

6.1.2 The Cornerstones of GDP

There are four corner stones which shape the GDP and make it unique:

- **QDCF:** The quality represents project quality which has to be right. The delivery indicates the delivery precision. The decided delivery time has to be met. The total cost is both project cost and product cost targets together. A feature is the way in which the customer can and normally does express her/his expectations, requirements and needs from a product or service.
- **Cross functionality:** All different kinds of people with the different skills involved in a project have to cooperate and have to inform each other about the project in order to be able to develop the best possible product. The purpose of the project review is to prove the status of the current gate criteria, plan the preparations for the next gate and predict requirement fulfillment, risk level and final delivery according to the project scope.
- **Risk Management:** there are risks involved when running a project which have to be managed. The risks need to be reduced.
- **Organization:** Project management drives the project and is represented by the Pre-Study Leader, Chief Project Manager, Project Management Team and the Project Managers.

6.2 – Strategy

The Strategy at Volvo is usually a business plan model that expands at least 3 years from now. The plan set for 2013-2015 is confidential, and aimed at different functions and levels in the organization. Vision and wanted position is set from the top and it is the responsibility of managers and directors to implement and act accordingly to reach the vision set out.

There is no surprise that one of the main focus points in this strategy is the focus on reduced lead time in order to reach the market with new and updated products before the competitors.

Volvo CE has a strong long-term strategy to support reduction of average project lead-time. It is clearly pointed out that the focus should not negatively impact cost or quality instead it should be reached through increased efficiency.

No reward system is in place at Volvo, meaning no extra incentive to pass deadlines on time.

Volvo CE needs to look into a way to prioritize on both projects level but also on line functions, departments or employee level. Respondents feel that a lot of time is wasted on resource leveling, trying to measure time and resource needed, instead of solving the problem.

Main challenges;

- Strategy slogan "One common vision, one commonality" – Important not to forget that Volvo CE are a global Company and need to adapt to the needs not only to customers but also organization and staff, so the full potential is used.
- Effectively utilize the resources and "know how" already in place today.
- Product planning – to position for the future, and have it aligned with component plans, secure technical solutions in time for project launches.

The main process Volvo CE will have to support its strategy is;

- CAST (Common Architecture Shared Technology), new process thinking with focus on common modularity.
- CLIP – Cut Lead-time in Project – focus on lead-time in new product projects, parallel working, and cut lead times in activities performed by line functions. To have a clear ownership of responsibility.
- Project Pattern – Template to apply on projects (classification A to D), classifications based on volume, cost, complexity, Reliability Growth prediction. Developed through best practice. Used as a baseline in the project, to get estimation on the time the project and different time line functions should spend.

6.3 – Organization

Volvo Construction Equipment is a big local company with its head office in Brussels. Volvo CE has today about 15000 employees worldwide with R&D and production plants in four different continents. The requirements set on such a global organization are very big. To cooperate between the different parts of Volvo CE in different continents requires good communication between different company cultures.

There are huge tasks in front of the organization in order to align into a front load activity. Resources should be mobilized at an early stage of the product development phase, so all risk

are clearly mapped and identified and all functions know what is demanded from them. Changes at later stage will increase inefficiency and stress resources.

When discussions are raised to reallocate resources between existing projects; it is crucial to visualize the obstacle so all stakeholders understand and together take a joint decision in reallocation.
Machine and component development must align and run parallel not to wait for each other.

Some respondents believe that in order to reduce lead-time focus should be on centralization. Common technology should be shared, but the actual development and decision making for the specific product should be centralized. This to create expertizes in the field and facilitates the knowledge sharing. Centralization will also shorten the decision lead-times.

Main challenges;

- Cultural differences and organizational cultural differences are also to be considered. As an example some cultures are very flexible when it comes to working hours and overtime.
- Lead-time measurements should be from concept study gate to release gate. The measure should be the same for all global sites, it is not clear if that is the case. Korea is often referred to as the most effective site, but as far as we know sites have not been compared. It may be a culture aspect to consider as well.
- Optimize resources. Line functions supporting the project could be occupied with several projects at once.
- Size of organization, clear decision lines. Decisions need to travel in the organization until it reach the right level allowed to take the decision. According to respondents several reorganization structures have recently been implemented causing early delays when trying to understand who owns the problem. When concepts/components are between two line functions – who own the component solution?
- Product similarity. All business lines are measured in the same way; however some product lines may have more common components between their different models, therefore some tested components are already in place.

The tools available for the cross functional organization is;

- Business Opportunity Description (BOD). The BOD should give the background, describe threats and opportunities and suggest changes or additions to the product characteristics. Easily explained the BOD is the specification to the project. BOD may have detailed specifications due to standards or legal requirements; otherwise it can be very detailed or very vague. Common in Sweden is that is has a broader approach giving the team members creativeness to explore different possibilities, this usually leads to more time spent at later stages. The BOD input is provided from different functions in the organization from Market to Aftermarket.
- Result Based Product Modeling (RBPM) – instead of asking just for resources you ask for a specific solution.
- Lean Management. To reduce waste and introduce frontloading activities. For example previously, resources have been distributed evenly throughout the project. Now a more frontload approach is being implemented, which is strongly supported from top management. The idea is to overcome later changes in the project if solutions can be established early on.

6.4 - Knowledge

Volvo CE has always been good at solving problems that appear, but have a long way to go when it comes to re-use what we earlier learnt. To care, tender and systematically collect knowledge for easy access to all, is a key to improve our product development.
Background of our project members varies from senior members to newly appointed, from consultants to permanent. A well-known problem is shortage of skilled resources. Often key personnel are occupied with other tasks or other projects. Hire or use consultants and insert them where needed might be as a good solution. However this usually results in longer start up phases, as new members needs to understand and get information about the ongoing details. There is a lot of knowledge on the individual level in the organization. Today the knowledge is spread through cross functional meetings, or through the structural organization.

While Volvo through the size of their organization could use knowledge, through different time zones the risk is to have the project members decentralized which would need an excellent process in order to share and understand information and knowledge.

Main challenges;

- Recruit and secure skilled personnel.
- Encourage expertise competence, individual knowledge/”know how” could be better maintained and shared, no good practice today in place to absorb and share the individual expertise. This is currently being looked into how to raise the status level of individual experts, for example, implement titles on competence level matching those of managers, director, titles.
- Knowledge sharing, easy access in a simple and systematic way, share knowledge and “know how” within the organization. To gain focus in Volvos organization it must be possible to measure how the use of a systematic knowledge base would lead to improvements in the development and of course the reduction of lead-times. Until a reliable and valid measure is available it would be hard to convince the organization to add resources to this.
- Having consultants involved is a risk when these are placed in key positions, taking the knowledge with them when they leave.
- Right level of competence at the right time. For example a less complex task should not occupy the expert and guru. Today difficulties are that there is a wider base of junior than senior competence in the organization.
- Third parties, not only the in house knowledge is crucial but also third party supporting functions such as supplier. Having a supplier close by who can easily attend physically to get feedback or instruct will facilitate the knowledge transfer.
- Global size, how to handle the spread in the organization? Meetings need to be scheduled and organized to share experience/plans/knowledge – this takes additional time from the daily work instead of easy access to colleagues.

Tools in use;

- White book, as a diary documenting the work. The knowledge learnt from earlier experience needs to be systematic, logical and easy to access. White book should function as a relevant lesson to the organization and to roles involved in the project. Unfortunately it is not easy to extract needed information.
- Best practice, only to some extent, but only within project office members in Eskilstuna not across the different regions. Usually mouth-to-mouth – therefore the benefit of centralized departments.
- Outsource, unfortunately often tend to spend more time understanding the culture and way of working within Volvo CE. Leading to longer lead times, at least in the early stages.
- Mentorship, is hardly used, possible might be that it is not widely known.

7. Theoretical Framework

This chapter will describe theoretical knowledge, tools and methods available in product develop process and the different phases surrounding development process from start to the end. The theory will highlight Time-to-Market strategies and practices to use when focusing on cost and quality while reducing lead time, during product development. In addition the theory will also touch on Time-to-Market strategies to be voided.

7.1 Product Development Practices with focus on Lead-time

Product development processes in organizations today are becoming increasingly important. Cost and development time-to-market will have a direct effect on the competiveness of an organization. With globalization an increase of competition is seen. As a consequence the planning and effectiveness of the product development process may jeopardize the existence of an organization. (Khazanet, 1997, p. 16: Srikant et al, 1997, p. 452)

7.1.1 Time to Market Strategies TTM

Times to Market Strategies (TTM) are needed in markets with supplier constraints, high development costs, low margins and high tech industries. The advantages are numerous but it is important not to forget about disadvantages such as “acceleration trap”. Preoccupation on speed might lead to lower creativeness, quality, ineffectiveness and hidden cost such as headcounts. It is crucial to find the right balance with cost and quality control as well as customer feedback. The result should be to deliver the right product at the right time.
The varieties in TTM practices shown below have been divided into three categories. Frequently cited literature, less cited in literature and practices to avoid. (Katz et al. 2005, 47-57)

Table 1, Time-To-Market-Strategies according to Katz et. Al. (2005)

TTM Practices Frequently Cited in Literature			
Practice	**Definition**	**Advantages**	**Disadvantages**
Stage-Gate Development Processes	Phased development with decision points interspersed at specific stages of the process	Quality control	May slow process if gatekeepers are not intimately involved with project
Cross-functional Teams/Program Management	Individuals from all functions within a division working together under the loose supervision of a program or project manager or coordinator	Minimize miscommunication	Can cause conflict if employees face competing demands from functional manager and project/program manager
Concurrent Engineering	Design, manufacturing and marketing plan simultaneously. May involve customer input in design phase	Cuts development time. Reduces the number of changes to the design during later stages of the development	May increase amount of time in design phase.
Reduce Design Complexity	Simplify design and/or reduce amount of change	Cuts development time. Less need for testing, less room for error	Reduces innovation
Design Tools/Use of the Internet/Information Management	Use information access and design automation tools to speed development	Cuts development time, Improves communication	Potential over-reliance on tools
Design for manufacturability	Consider the manufacturing process in the design stage	Reducing needs for redesign or reengineering and thus improves TTM	Requires close coordination between areas.
Focus on Value-Add activities	Concentrate on work that is essential	Eliminates redundant and/or unnecessary work.	May cause tension as traditional ways of working are discharged

Table 2, Time-To-Market-Strategies according to Katz et. Al. (2005)

TTM Practices Less Frequently Cited in the Literature			
Practice	**Definition**	**Advantages**	**Disadvantages**
Rewards	Provide monetary (cash, stock, options) or personalized (plaques, certificates, gifts) rewards.	Relatively easy to implement	Need to establish criteria for rewards. Can cause tension among workers. Temporary incentive that loses effectiveness with time.
Senior Management Support/MBWA	Manager spends time on the floor/in offices informally talking to employees and observing	Promotes two-way communication. Allows employees to express concerns, managers to learn about employee attitudes while observing progress	Can be disastrous if manager is not casual, comfortable and open. Can be misinterpreted or viewed with hostility.
Lead-User Involvement	Include customers in the development process.	Improve fit between product and customer requirements.	Can add time to development process unless rapid lines of communication (e.g. Extranet) are set up.
Quality Function Deployment (QFD)	Structured procedure that allows organization to focus on customer wants and needs	Produce products and services that meet customer needs. Reduce needs for redesign.	Difficult to use in large design projects.
Product Platforms/Design Leverage	Use existing products to develop new products	Reduce development time. Reduce errors/problems.	May decrease innovation.
Organizational learning	Documents and share best practice. Organize learning teams to create and share knowledge.	Reduce cycle time. Improve communication.	Takes a long time and can be heavily impacted by people leaving organization.
Risk Management	Identify and resolve risk before problem occurs.	Minimize likelihood and impact of risk.	Potential over planning.
Communication	Communicate the importance of TTM to all participants in the process. Maintain communications.	Encourage participation in new practices; minimize possibility of miscommunication.	Must be sincere, consistent and supportive in action as well as word.

Table 3, Time-To-Market-Strategies according to Katz et. Al. (2005)

TTM Practices To Avoid			
3 most frequently mentioned To Avoid			
Practice	**Definition**	**Advantages**	**Disadvantages**
Adding headcount	-	-	Seen as ineffective and costly
Target costing	-	-	Which can have a negative impact on product cost, quality and development time
Rewards			Has both opponents and proponents in the literature on TTM Practices.

7.1.2 24 by 7 approach

Competitive forces in international market drive product development to drastically lower their time-to-market cycle. A solution might be the 24 by 7 approach, working 24 hours seven days a week. When sun sets in Europe, America steps in to work until they are released by Asia. The main challenges with the 24 by 7 approach is exchange of information, methods to coordinate and supportive tools. Here researchers have unknown soil that needs to be examined (Ronald & Scott, 2001, p. 48).

7.1.3 JIT – Just In Time

The principle of JIT in manufacturing has shown to also improve new product development processed. JIT principles focus on elimination of waste, by adopting total quality management, continuous quality improvement, reducing set up times, and flexible resources. Companies who adopted JIT developed new products with better quality, in less development time, lower development cost that lead to lower manufacturing cost. (Meybodi, 2003, 116,118)

7.1.4 Front Loading

The principle of front loading, identify and solve problems at early stage of development process, by utilizing more resources at the beginning. Later change in a product development phase drives costs higher and takes more time and resources. The intention is to develop new products at a lower cost and with reduced time. (Thomke & Fujimoto, 1998, p.2-8)

7.1.5 Best Practice – learning from previous experience

Repetition and mistakes that are unnecessary "reinventing the wheel" is the single most costly driver organization face in product development. Ensuring that knowledge is transferred in an organization is essential in the long run for the improvements and success within product development. In order for successful inter-project improvement, also referred to as learning or knowledge transfer, a clear structure and systematic approach to facilitate inter-project improvement must be in place. This can be made by having knowledge shared electronically, in person or through documents. All knowledge made must be available for future projects to gain quality, cost effectiveness and reduce the development lead time. Even though a detailed, documented and up to date development process it is crucial to ask project members when they last looked in the "handbook" or guidelines. The frequency will have effect on what efforts should be put to keep it up to date. It has also showed that product knowledge are more desirable then process and method knowledge. Preferred media to receive information is not through documents or handbook but from people directly. This shows the importance of skilled project leaders, available mentors and regular project team members. (Antoni et. Al 2005, p. 876-878)

Savings in cost and time can be gained when product architecture allows sharing in modules, parts, or similarities over product families. (Jianxin et al, 2007, p.14)

7.2 Product development phases

The major phases in a product development before approving a product are;

- Develop a product concept based on needs
- Prepare the feasibility study on the product itself and the marketing around it, from a technical and economical point of view.
- Prepare drawings, plans, specifications, cost estimations, and incorporate in research

(Khazanet, 1997, p. 16)

According to Mattimore (1995) Five stages can be identified in the product development phase;

Stage 1 - Idea: Concept is identified; validity and market opportunities on idea's are evaluated. The aim is to conclude whether it is a business opportunity and competitive advantage or not.

Stage 2 – Concept development: Feasibility study is made through market research and a clear strategy is put in place. This stage is to determine whether a concept should be terminated or not. It is crucial to end unfeasible concepts early in order to not spend money and resources in vain.

Stage 3 – Design and development: Turning idea into a functional product. Involving engineers, design team and prototype manufacturing.

Stage 4 – Testing: How does it work in the market.

Stage 5 – Commercialization: Gathering resources for effective exposure of the new concept into the market. Requires the whole company to put in their efforts from manufacturing to marketing and public relations. (Mattimore, 1995, p. 38)

7.2.1 Early Phases

Early phases is a new a developing model which focuses on the early phases.
This model is developed by the Hauler and Loader division, Volvo CE Cab division and Components division. All these are today a part of Volvo CE Technology. The main reason behind this was to do it right from the start. It has been quite common with late changes in the product development process which normally both increase the total development cost as well as lead to delays.

Not only the delays and extra cost are unwanted but also the occupation of the resources. The resources are normally needed for other projects. The purpose of the introduction of the early phases is to create better development possibilities in the early product development work through increased cooperation, structure and control.

The Early Phases contains four phases:

• Business Opportunity Description (BOD)
• Feasibility Study (FS)
• Pre-Study (PS)
• Concept Study (CS)

The Business Opportunity Description and Feasibility Study are two new phases added to the conventional and existing development models. The Pre-Study and Concept-Study phases are already established in the existing models while in the early phase's model these are revised somehow.

7.3 Measure Product Development Performance

Companies need to identify the sources of problems and at the same time document the reasons to their success. (Mallick & Schroed, 2005, p. 144)

New product development literature has presented the following performance metrics being used in the product development process;

- Measure of Research & Development resource utilization
- Measure of development time utilization
- Measure of product performance
- Measure of production cost
- Measure of market success
- Measure of financials success
- Measure of overall commercial success

It is not defined if a single metric is sufficient to measure product development performance or multiple metrics are necessary. It is not defined or examined which metrics indicate what would provide best result. It gets even more complex when looking upon a single project or the product development program which a project is run through, since projects within a program may have different objectives the performance metrics used for measuring these projects are different and may be in conflict with each other. (Mallick & Schroed, 2005, p. 142ff)

Time frame must be addressed in particular when performing measurement metrics. Metrics for short-term performance may not be suitable for long-term performance, instead the metrics must be in alignment with the desired timeframe. Failure to do so might result in short-term gains at the expense of the long-term objectives. (Mallick & Schroed, 2005, p. 144)

7.3.1 Gates and Management Targets

An example from a Japanese electronics manufacturer show that management target of reducing product cost by 30 per cent, on the project team had a negative impact on the time-to-market factor. The team managed to meet the target, but did so by increasing the product development time and as a consequence introduced the product too late to its market. ((Everaert & Bruggeman, 2002, p. 1341)

Everaert & Bruggeman (2002, p. 1341.) examined, if new product development projects assigned with a cost target to design engineers would harm design quality and increase development time. Contrary to believed, a cost target did not affect the design quality, but it showed a clear increase in development time. To conclude it was shown that cost target leads to lower product cost only when the team face time pressure.

7.4 Managerial Implications

Cost targets should be used with cautions, while it prevent the “if we just add this feature, the product will be so much better and only cost a little more”, it will have a negative correlation when the project team is faced with a sharp development time objective. Consequently in price competitive markets a cost target should be applied, but if instead the focus is on the time-to-market, management should rely on the creative power of the design team. ((Everaert & Bruggeman, 2002, p. 1351)

Antoni et. Al (2005, p. 876, 890) found in their studies that in order for organizations to learn from previous projects, they should use multiple strategies. The results shows that a combination of project diaries, well established product development process and professional full time project managers is a must in order to reach the full potential of knowledge transfer. In addition modularization is an effective strategy to share knowledge across projects and tends to reduce cost and product development time. It has also been showed that rewards appear to be

an ineffective way to decrease development lead time. Instead they lead to mistakes or accidental, inefficient behavior.

Studies have shown the importance for management to establish explicit objectives and product requirements in new product development in order to keep and reduce product development lead time and avoid unnecessary recourses to be implemented. Thus keeping cost budgets in place (Swink, 2002, p.55,57).

Product development must be consistent with the organizational strategy, in order to move the idea quickly through the development process. Being ahead of competition allows the organization to benefit through premium prices, brand recognition, market shares, and enjoying the bottom line profit. (Meybodi, 2003, 116-117)

7.5 Lean product and process development

Lean thinking has attracted scholars and practitioners since the publication of "The Machine that changed the world", by Womack et. Al. (1990). Lean product development are known for short lead times, reduced requirements for human and financial resources, as well as products particularly suited to customer needs. It also increases the innovation and reuses production systems and parts, slashing capital costs and improves the quality.
Lean thinking has mainly been applied to either the entire value stream, or to distinct sub-processes in a company manufacturing shop floor. The area of potential with lean thinking and implementation is the field of product development. (Hoppmann et. Al, 2011, p. 3: Gould L.S., 2006, p. 64)

Maybe the most known and studied product development system is the one of Toyota. Comparisons of the western approach against the Japanese at Toyota, showed distinguishing differences. Japanese product development projects made use of overlapping development stages, and during the product development phase the Japanese followed a large number of alternatives for the same product module. Result showed that products were not only better but also produced in less time. (Hoppmann et. Al, 2011, p. 4)

In the lean development system the development process is built up around the goal of learning compared to conventional development which is built up around getting people to follow orders. (Lean Product and Process Development, Allen C Ward 2007).

7.5.1 Lean management secret

The job of lean management is to help order emerge by learning and helping others to learn, (Lean Product and Process Development, Allen C Ward 2007). Once you know how, lean management is a lot easier than telling people what to do. In lean organization, the people need to see the effect of their work, so they don't have to be told what to do. Simple, universally used profits measures help create an information field that guides people to do the right thing.

7.5.2 How to reduce wastes in development

Lean development focuses on creating usable knowledge and equipment – knowledge and equipment that contribute to consistently profitable operational value streams.
The output of the development, runs from the suppliers through plants into product features and out to customers. Every link in the process is critical. A project is considered as failed even if the product is good, if the manufacturing is bad or if the supplier is weak or the customer unhappy.
Important points to reduce the waste in development:

- It is important to know what the customers want and how integrate the products into the legal, physical, and supplier environment.
- It is also important to know own development and manufacturing capabilities and how they can be used to provide customers desires and at the same time beat the competition.
- The physics and aesthetics of own product.
- The capabilities and limitations of the supplies used and how these can be best integrated into own system.

It is also of great importance to make sure that all these things fit together and interact to make better operational value streams.

7.5.3 Organization of lean companies

The development teams deliver knowledge value to the operations department and the manufacturing cells deliver value to customers. Everything in the company needs to support development teams and manufacturing cells; it is there where the value is added.
How are lean companies organized? In lean companies, normally the project managers are both entrepreneurs responsible for project profit and system designers responsible for designing the value stream (Lean Product and Process Development, Allen C Ward 2007), but lean

companies need and have strong functional departments which house most of the developers. For example they need to have a body, engineering, styling, or manufacturing engineering to build knowledge. The project managers (also called chief engineers at Toyota) supervise only a few assistants to avoid the matrix organizations. The negative of the matrix organization is that people will be forced to work for two bosses, the value stream leaders should be busy improving the vale stream to manage the developers, developers needs to have functional managers to hold their attention on creating knowledge instead of focusing on finishing the current project and the specialists need to be able to tell the value stream designers that they are wrong to be able to force compromises.

Also pure product line organizations have great difficulties, mainly in learning across projects. The figure below shows how a lean organization works:

- The president of the company is responsible for making money and for all the value streams.
- Project and business-line leaders, support the president and like him/her are responsible for making money.
- Front-line developers, such as, working engineers, purchasing agents, and marketing researchers support the value stream designers and they create most of the knowledge value that goes into the product.
- Functional department leaders support front line developers by helping them to organize their knowledge across projects and funding concept work not yet ready for projects.

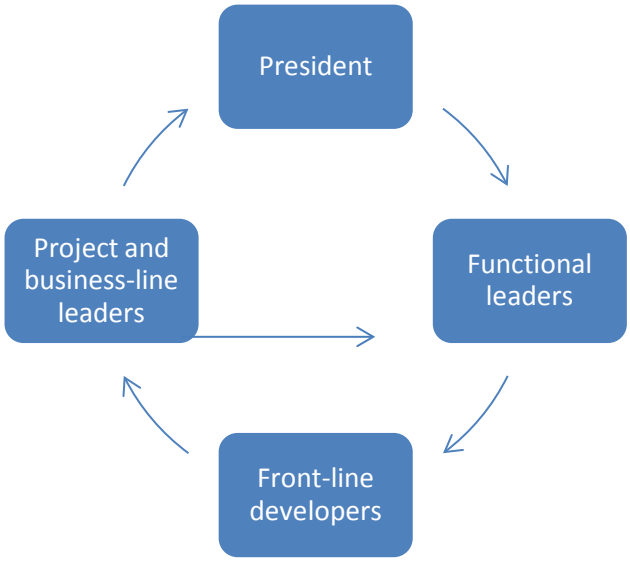

Figure 4. Ward page 73

8. Analysis of gathered data

In the section analysis of gathered data all findings from the interviews conducted will be dissected and all observations will be discussed and set against the theory and literature studied and described in chapter 6 as well as author thoughts. The chapter is divided in three areas, strategy, organization and results just as in figure 2.

8.1 Strategy

Just as Meybodi (2003) states in order for an organization to benefit through premium prices, brand recognition, market shares, and enjoying the bottom line profit, product development must be consistent with the organizational strategy. Volvo CE has a clear strategy focus in place to reduce project development lead-time which is supported throughout the interviews made. All respondents feel the message has been clearly communicated and has a high management focus. However the interview respondents are clearly stating that none or very limited knowledge is shared and that there is nothing clear stated in the strategy which emphasize the importance of knowledge sharing. This shows a lack on strategy initiative to support the knowledge sharing within the organization.

The respondent results clearly state that in order to reach the targeted strategy, the organization need to work more effectively and the key for this is through optimal resource utilizations. More about how to increase the efficiency described in the section organization and knowledge below.

8.2 Organization

Volvo CE being a global organization spread all over the world, is today considered an advantage. These sites have different knowledge level, different way of doing things and different culture. What has been shown is that this global organization comes also with some negative aspects such as having reporting managers in other location, which limits the daily face to face communication. Cultural differences are other negative aspects where the reporting manager might not always know all rules or regulation which the employee is working under. This leads to misunderstandings and miscommunications which results in things that need to be redone or explained, consuming valuable project time.

Members of a certain project can also be placed in different locations benefiting from the different time zones, but at the same time, the different time zones will be in the way and might cause delays whenever project members need to communicate with each other. The distance also limits the face to face meetings especially whenever the company needs to save money. When the market is going down the first action taken is to apply travel restrictions, which limits the important face to face communication. As Ronald & Scott (2001) emphasis a spread out organization put high demand on the organizations efforts to share information, methods to coordinate and supportive tools. This is an area for Volvo to improve as will be discussed further in chapter 9.3

As observed during our work with the thesis we realized that Volvo CE doesn't provide any communication tools with video possibilities and that is some cases the employees are not very familiar with all the communication tools available. These communication tools are of great importance as they are used in the daily business and the project meetings.

Just as highlighted by Ward (2007) the negative of the matrix organization is that people will be forced to work for two bosses; this was pointed out during the interviews which shows that ownership is not always completely clear for complex component also causing delays.

Respondent results have shown that projects are often running parallel, which hampers the front loading activity which needs to be put in place. Front loading activities means putting in a higher man force into the early stages of a project and this demands that the projects are running with some overlap.

Respondent results have shown that product projects are launched although the component is not ready. Due to a solution not being in place, a simplified or old technology need to be chosen instead, resulting in project delays. Other models such as those produced by Korea shows a lower project lead time, based from the interviews this could depend a lot on the similarities of included components. The same statement is supported by Jianxin (2007) that savings can be made in cost and time when product architecture allows sharing in modules, parts, or similarities over product families. Here we see a strength with the tool CAST (Common Architecture Shared Technology), which Volvo CE is currently using.

8.3 Knowledge

Volvo being a big global organization has a lot of knowledge in the form of all the employees working with the product development, production and other functions. All these employees are the most important asset that Volvo possesses. This means the company must do everything to keep the knowledgeable people with the company and develop them. The projects need these experienced people to be able to work efficiently. In some of the Volvo sites there is a tradition of continuation meaning that the employees stay in the same function for very long time gaining experience, knowledge which results in working efficiently.
Continuous improvement is a fundamental part of the lean principle, and how can continues improvement be reached if not with the continuation of the workers. In other company sites such as in Eskilstuna people still have the tradition to continue to work within the company, but they tend to change direction within in the company more often compared to other sites. This is of course positive since these employees gain a broader knowledge, but of course there is the negative aspect of the take off period required whenever someone carrier path change results in loss of efficiency. Volvo is today promoting the role to become an “expert” within certain areas, this to encourage the employees to develop within their area of expertise. This is of course positive, but we realize from the information gathered that even though this expertise program is in place the rotation is still on a high level. Respondent indicates that the drive for rotation is increased salary. Therefore more must be done to keep the right expertise and increase efficiency.

Just as important as the individual knowledge is also to share knowledge and lessons learned within the organization. Sharing knowledge would result in reducing the waste which is fundamental and probably the most focused principle in lean organizations and to eliminate the waste, the activities which consumes resources but create no value for customer has to be eliminated. It has been shown that the project team members in Eskilstuna conclude their result in “white-books” that describes obstacles and solutions during the project lead time. However the information is not systematic, easily obtained or even mandatory for project team members to review before launching new projects. Antoine et al (2007) points out that knowledge made must be available for future projects to gain quality, cost effectiveness and reduce the development lead time. The findings from interviews have shown solutions found from previous projects, and that they could be avoided through the reviewing of previously issued white book.

Objective;

- Investigate if the knowledge sharing with Volvo CE is ideal for reducing project lead time. Though lot can be done to share, keep and encourage knowledge sharing within Volvo CE as per our recommendations below.

The recommendation to Volvo CE based on Knowledge sharing is;

- Include knowledge sharing as strategic objective. Management and leaders must have the support to develop tools and processes to improve the knowledge sharing within the organization.
- Reward individual expertise. To avoid skilled personnel leaving for other positions, swapping to competitors or other industries. This can be done through the usual reward in terms of salaries and bonuses but also to titles such as Experts, Gurus. To give such titles in combination with higher salaries and a higher status corresponding to the same status as Directors and Vice Presidents, also increase their voice in crucial decision. All this will help the retention of the specialists and build up knowledge.
- Implement mandatory review of previous white book for all project leaders before the project launch. This is needed not only to utilize the lessons learned and the knowledge sharing that has been in place. Maybe more important is to have a wider range of employees accessing these white books and that they may add their recommendation on how it could be developed and what media to use to share the information.

8.4 Visualized in concept model

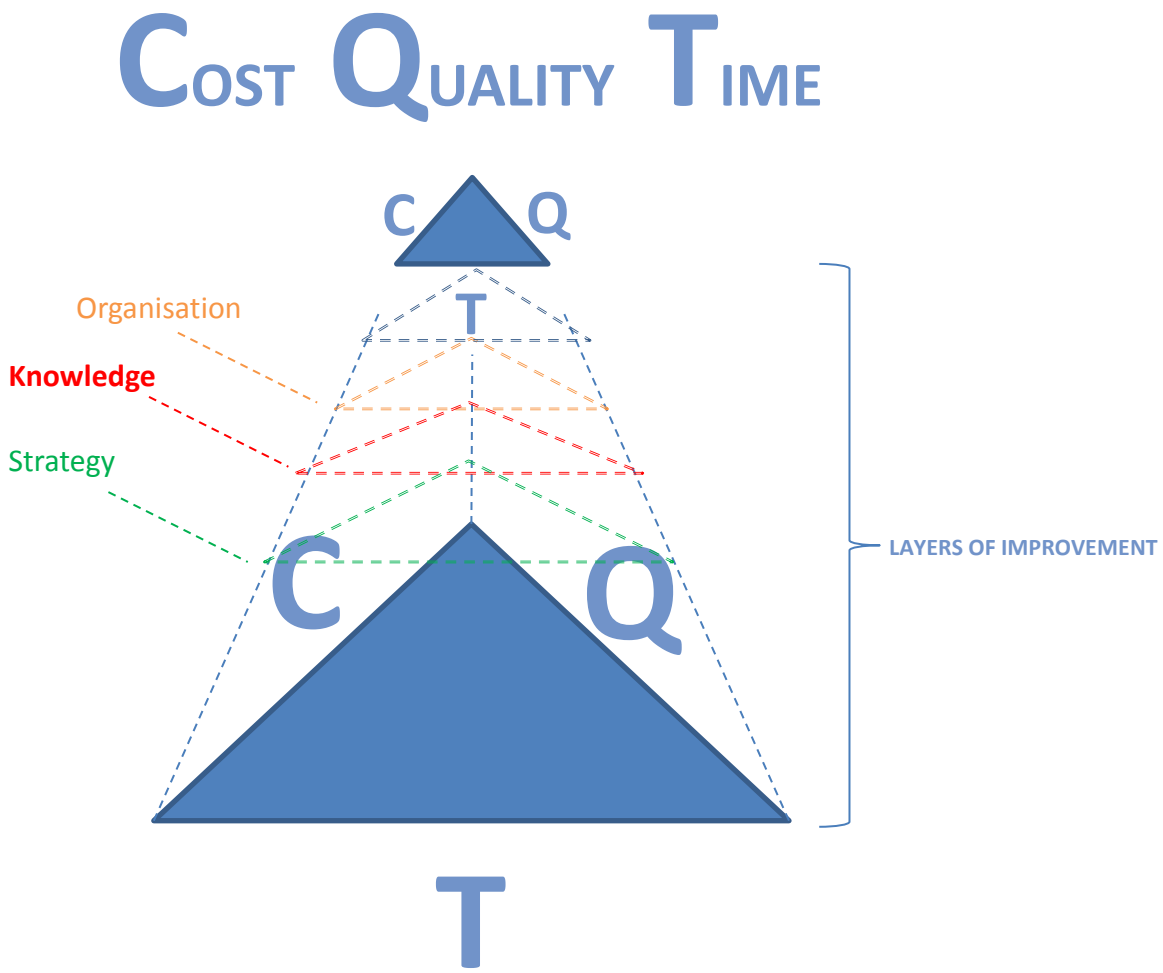

Figure 4 – own model

Our model visualizes how the different areas within Volvo CE affect the size of our triangle to the wanted position of minimization. The different colors symbolize the status of the different layers. Green – on track, Orange – corrective actions and careful monitoring needed and Red – Need improvements.

Strategy – Volvo CE has a clear strategy communicated throughout the organization highlighting no negative effect to be made on quality or cost.

Knowledge – Volvo CE need to take corrective actions in order to ensure business knowledge learnt and available in the organization are shared in best possible way, while still premiere the individual knowledge. This can be through titles corresponding to manager levels and increased salaries to experts.

Organizations – Volvo CE has the global organization in place to benefit from the large scale synergies, however it is crucial that gaps in ownership are mapped and closed. Document all uncertainties, where more than one manager is asked for decision. Corrective ownership actions should be considered where there is a high density of unclearness.

9. Result

This chapter presents our results to the objectives that were set in the beginning of this thesis. Recommendations for improvement actions where needed will be presented in chapter 11.

9.1 Strategy

The strategy to reduce product development project lead time is clear and anchored throughout the organization. Also it is well known that this focus should not affect cost or quality. Respondents result shows that this can only be accomplished through effectiveness; otherwise it will affect cost, quality or lead time. There is nothing mentioned in the strategy on knowledge. Based on the interviews, we have found that there is a need to keep skilled employees not only within the company but also in key positions.

Objective;

- Investigate if the strategy at Volvo CE is in alignment with reduction of project lead time. Yes, however more focus on the knowledge within the organisation.

The importance of knowledge is further described in chapter 11.3

9.2 Organization

Volvo CE has a global organization spread worldwide. People with different culture, language, time zone and background are working together through face to face meetings, communications medias and common system. Reporting managers or task owners may be located in other geographical sites. Respondent results have showed it increases lead time in decision caused by misunderstandings. Furthermore respondent results have shown ownership is not completely clear for complex component also causing delays.

Respondent results have shown that product projects are launched although the component is not ready. Due to solution not in place, simplified or old technology need to be chosen instead, resulting in project delays.

The objectives of this thesis are to;

- Investigate if the organisation is right sized and efficient in order to reduce project lead time. The organization feels to be right sized, but not fully efficient as per our recommendations below.

9.3 Knowledge

Respondent result has shown that project product development history is documented in so called “white books”. The white books show the solutions and obstacles overcome, but are not written or stored in a systematic way and only share negative experience not success stories. As a result these are seldom used for latter project starts. Not sharing knowledge within the organization leads to doing same mistakes again as well as spending more valuable time on recurring activities which in turn causes project delays.

- Investigate if the knowledge sharing with Volvo CE is ideal for reducing project lead time? Though lot can be done to share, Volvo CE must look into how to keep and encourage knowledge sharing within Volvo CE.

Respondent result shows that the individual knowledge needs to be maintained better and premiered not to lose the competence to other functions internally or competitor.

10. Analysis

In the section analysis we will reflect over the study conducted. We will also discuss what more could have been done and what weather the result is reliable.

10.1 Reflection

In total 5 interviews were conducted with different stakeholders, mainly holding project manager or chief project manager positions. But also some discussions were hold with other stakeholders during the visits to Eskilstuna office. In general the interviews were held in a very open environment and the stakeholders were expressing themselves freely especially as the researchers are also Volvo employees. The main issues though out the study have been to find the right time as well as enough time to have the interview since the stakeholders have been extremely occupied. Two of the suggested stakeholders canceled the interview since they had no possibility to attend the interview because of time shortage.

We still believe that the information gathered and the result presented is reliable since we could find that the stakeholders provided us with similar information and shared to a quite a high extent their opinion.

10.2 Further studies

As mentioned earlier an important area which should be studied is to map all the different functions of the products to avoid any kind of misunderstanding leading to long decision time which have a great impact on the time spent on the projects.

10.3 Implementation of improvement actions

The implementation of adding a new key focus area to Volvo CE strategy to focus on the knowledge level is a rather simple task, but working with it is probably harder since it is all about changing the mentality of the leaders and getting them to understand the importance of this area is rather difficult. We believe that for such an area to get more focus it has to be connected to one of Volvo CE's other high focus area such as CAST and CLIP.

To map functional intersection points is a time consuming task which should if done properly give noticeable result on the reduction of project lead time since this is a known problem at

Volvo CE especially because of the size of VCE as well as the spread of the development teams. As well as working with RBPM should be easily implemented and the result should be possible to measure especially as the organization today is suffering from being ineffective according to the information collected. Adding resources to a project is not like adding competent resources.

Measuring the readiness of the components is a measurable improvement. By measuring e.g. the number of the test hours and fulfillment of a specification it is possible to define the maturity of the product and then decide whether to include the component in the scope of the new project or go for another solution.

To improve the cooperation and collaboration between the different sites, it is necessary to constantly work with the improvement of the cultural knowledge as well as keeping the possibility of face to face meeting open even during recessions. Having good communication tools is also a fundament in today's work environment. Even in this case it is difficult to measure the outcome of such improvements but without any doubt good communication is a corner stone which most authors and researchers point at.

The requirement to review a relevant white book for all project managers before the start of a project is measured easily and could be reported to the manager to keep pushing for the importance of it.

11. Conclusion and Recommendation

Chapter 11 will be the author's conclusion and final recommendation based on the purpose definition and purpose and objectives set from the beginning of this thesis.

11.1 Strategy

Volvo CE has a good strategy in place which has been anchored throughout the full organization and supported from top management. This is also supported by all the new initiative started and tools and processes in place to support the reduction of project lead-times. Concern from authors was the loss of quality focus, however Volvo CE supervisor has pointed out that there is a target in place to follow up on warranty claims.
The authors would like to add to the strategy a value added directive to maintain and develop knowledge within the organization.

Improvement action to Volvo CE is to add strategic objective to maintain and develop knowledge within the organization. In appendix F Volvo's strategy for 2013-2015 can found, the recommendation for Volvo CE is to add a new Key focus area no 10 to this strategy. A suggestion for the new key focus area can look like below:

- Key focus area no. 10

  Maintain and Develop knowledge share within R&D
  Strategic objectives
  10.1 Achieve higher levels of employee retention
  10.2 Achieve a 15-point improvement on the number of specialists within R&D

11.2 Organization

Volvo CE has a global organization in place to support its different functions. This demands clear decision lines, processes and tools to support all involved. It has been shown that geographical spread and ownership to decisions are sometimes a concern of delays in lead time.
Volvo CE also needs to benefit from its large scale operation in order to be more efficient and reduce the lead times mainly through front load activities. This is only possible within Volvo CE if projects are running with some overlap.

Alignments between project launch and component readiness needs further examinations. As per respondents feedback there is no sign that Volvo CE today is measuring which models have highest rate of incomplete components on project launch date. A component not being ready at project launch cause project delays or an old component is used instead of new innovation. Volvo CE has some focus on this area with CAST who should work as a tool to implement more common components, but more can be done.
For Volvo CE to benefit from the globalization of the company and to increase the efficiency further, the communication between the different sites has to be improved significantly.

The recommendation to Volvo CE from an organizational point of view would be to;

- Map functional intersection points and conduct interviews to ensure ownership of receivables and deliverables are clearly defined, and drive actions where needed. This is a huge task that could be conducted as a master exam or outsourced to experts.
- Define resource needed –Define on project development stage, what resource is needed, what stage and how much? Define what type of resource is needed, simple or complex task? This is also a huge task, could RBPM be used and developed, or should Project Pattern be further developed to also include the resource need?
- Start to measure the component readiness rate on model level, to find the highest and lowest rank of component readiness. Based on result a best practice approach to find corrective actions is required.
- Volvo has to work on improving the cultural knowledge of each site especially the managers, who have reporting personnel in other sites (countries). This can be done through special custom-made training, teaching cultural differences and certain laws and regulations for all managers.
- To be able to benefit from the different time zones and the expertise available in different sites Volvo has to have a consistent strategy regarding the restriction of travels. Project members in different sites have to be able to have face to face meetings as this is invaluable.
- Volvo has also to offer and use very good communication tools where the video conference should be a part of the concept. Training about how to use these communication tools have to be conducted for all the project members.

11.3 Knowledge

It has clearly shown that a considerable high risk in Volvo CE is the dependency of skilled individuals and their knowledge, which is a key asset for the organization. The difficulties Volvo CE face is not only to keep skilled individuals and develop the knowledge but also expand and share it throughout the organization. The only real evidence showing this sharing of knowledge are white books and regular meetings, but feedback has shown that the white books are not developed in a desirable way for project members to take the time to study the material and in addition to that there is no real focus on the review of the white book.

The recommendation to Volvo CE based on Knowledge sharing is;

- Include knowledge sharing as strategic objective. Management and leaders must have the support to develop tools and processes to improve the knowledge sharing within the organization.
- Reward individual expertise. To avoid skilled personnel leaving for other positions, swapping to competitors or other industries. This can be done through several use of incentives such as the usual reward in terms of salaries and bonuses but also to titles such as Experts, Gurus corresponding to the same status as Directors and Vice Presidents, also increase their voice in crucial decision.
- Implement mandatory review of previous white book for all project leaders before the project launch. This is needed not only to utilize the lessons learned and the knowledge sharing that has been in place. Maybe more important is to have a wider range of employees accessing these white books and that they may add their recommendation on how it could be developed and what media to use to share the information.

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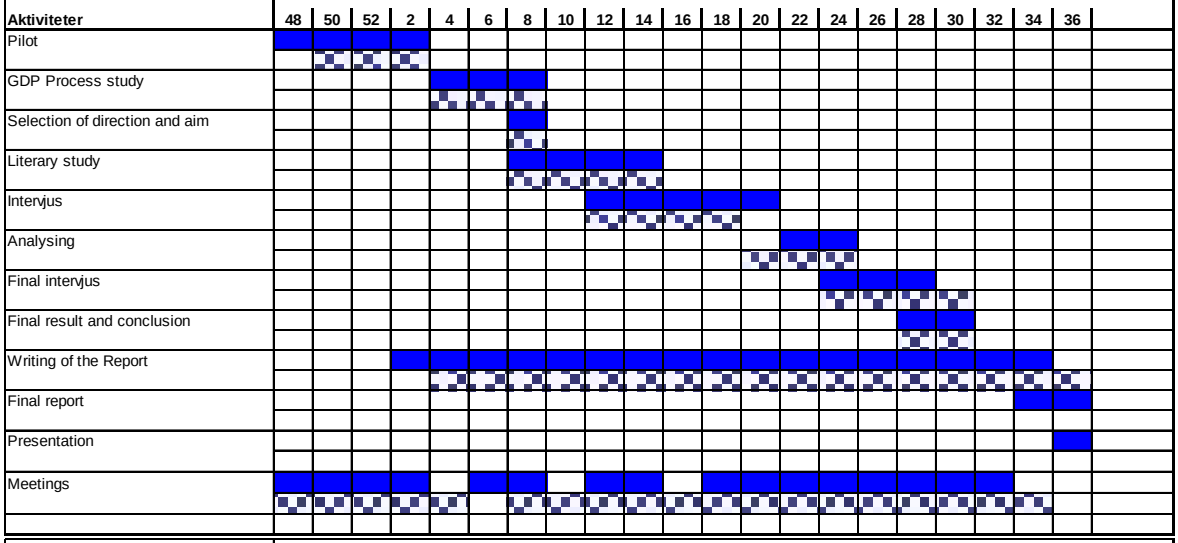
13. Appendix

A – GANTT Scheme

PROJEKTPLAN

Projektnamn	Beteckningar		Datum 2012-11-10	Identitet
		Planerat / Utfall	Revision	
	aktivitet		1	Upprättad av
Reduction average project lead time	hållpunkt	P / Q		Wael Wardi Fredrik Gustavsson



Resurser plan / utfall		Mantimmar 48	50	52	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	
Wael Wardi	**Plan**	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	420
	Utfall	20	20	40	30	30	5	10	0	12	20	30	10	5	20	20	30	16	24	33	20	20	415
Fredrik Gustavsson	**Plan**	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	420
	Utfall	20	18	30	40	35	10	10	20	25	20	25	10	12	20	30	10	5	20	20	40	20	440
Summa mantid	Plan	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	840
	Utfall	40	38	70	70	65	15	20	20	37	40	55	20	17	40	50	40	21	44	53	60	40	855
ackum.	plan	40	80	120	160	200	240	280	320	360	400	440	480	520	560	600	640	680	720	760	800	840	840
	utfall	40	78	148	218	283	298	318	338	375	415	470	490	507	547	597	637	658	702	755	815	855	855

B – Introduction Letter

We are conducting a survey for our Master thesis in Product Development/Process Management at Mälardalens University in Eskilstuna. In this thesis we are examining the lead times in product development project at Volvo Construction Equipment AB, in Eskilstuna.

The purpose of this study is to increase the understanding of decision choices available to project members, decision makers, and directors in multinational companies. Focus areas are on strategy, organisation and knowledge to illuminate potential risk in projects and project portfolios. The intention is to contribute to researches performed on time-to-market projects in multinational corporations. To be able to do this we would like to have interviews with Volvo CE personnel with relevant knowledge in this subject.

The interview will be written down in full so that we can go back to verify and confirm the content. The interview will take approximately 1-1:5 hours. In this study all participation is voluntary and the interviews can be terminated at any time and that no one except me and Wael will know exactly who has said what on which questions. This also means that the final summary of the interview in our thesis will be anonymous.

After the interview is finished its possible for the respondent to see and read the summary.

I hope that you would like to participate and share your knowledge and experience in our study. If you would, I kindly ask you to email me your answer so I can contact you regarding time and place for this interview.

If there is anything else you wonder about, you are welcome to contact me or Wael.

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C - List of Respondents

Respondent I: Project Management Engineer, Interview at Volvo Technology Center Eskilstuna, 7th of June, 5th of September, 2012.

Respondent II: Chief Project Manager, Interview at Volvo Technology Center Eskilstuna, 17th of June, 2013.

Respondent III: Projects Manager, Interview at Volvo Technology Center Eskilstuna, 26th of June, 2013.

Respondent IV: Director Lead Time Reduction program, Interview at Volvo Technology Center Eskilstuna, 6th of September, 2013.
23 years industry knowledge.

Respondent V: Chief Project Manager, Interview at Volvo Technology Center Eskilstuna, 20th of September, 2013. +25 years' experience within production, product development, projects.
CPM – Wheel Loader

D – Questionnaire

Authors	Keywords	Questions
Strategy		
Katz et al (2005) Khazanet (1997) Srikant et al (1997) Meybodi (2003)	Time To Market strategies	Which TTM strategies are currently in use? Could you descripe the PPD process to us and the different stages involved? To what extent are you using TTM strategies? Are these TTM strategies effecitive in meeting deadlines? Are you familiar with JIT strategy? Could you describe it? What does the TTM strategies cost in term of cash and rescurces? Are employees informed about TTM strategies? Is the product development in line with the organisation overall business strategy? What can be done to reduce the project lead time according to your experience? What can be done to meet project deadlines?
Katz et al (2005)	Checks, Gates	Do you face gates/checkpoints during the project that needs to be met? Are gatekeepers intimately involved with the project? Are gatepasses delayed? If so why? If not how is it prevented? What is your opinion about the number of gates?
Katz et al (2005)	Rightsize, find balance	In terms of rescources how is your project budgets when it comes to; Manpower? Time? Cost?
Swink (2005) Mallick & Schroed (2005) Everaert & Bruggeman (2002)	Objectives, Managment product requeirments	Are project/product specification clearly defined at an early stage? Do specification limits the project teams possibility to be creative? Are stakeholders (inputters) Managment involved over the full duration of the project? Are objects in conflict with each other? Examples? From a management point of view would you say the focus is on cost or execution on speed?
Katz et al (2005)	Rewards	Is there any monetary or personalized incentive involved in PPD?
Knowledge		
Jianxin et al (2007) Antoni et al (2005)	Best practice, sharing modules/parts	Is best practice shared between, project groups, members, departments, units, organisations etc? To which extent are modules and parts harmonized?
Mallick & Schroed (2005)	Document (keep record / lessens learned)	Are projects history documented? If so are lessons learned, and how is the information avaialable to others?
Antoni et al (2005) Swink (2005)	Team members	What background do the project team members have? Is it usually the same people? What background do the project leaders have? Is it usually the same person?
Katz et al (2005) Hoppmann et. Al (2011)	Modules, design, special tools	Are design worked on at an early stage in the PPD process? Are concepts carried on into later stages of the PPD process before elimnation?
Organisation		
Katz et al (2005)	Information, data,	How is information/data shared between members, departments, etc?
Katz et al (2005) Ronald & Scott (2001)	Crossfunctional teams	Do you feel that demands from other functions/departments are in conflict (suboptimize) with each others? If so how is it usually sorted? (managment decisions other) Are project members involved from differen time zones? If so what is your opinion in terms of teamwork and result?

E – Interview summary

Interview Respondent I

Global Development Process

Steering committee decides if the project is allowed to pass the gates. Different levels depending on size, classifications (class 1 to 3 – 3 biggest ones) of project and which gates that needs to be passed. Respondent I

Gate lead-times are often exceeded; reason varies such from gut feelings to budget not enough. The gates are also too administrative instead of practical driven. To measure the lead-times it is crucial to have the right measurements. For instance reduce testing, is one way – but in a sense it's also cheating. A new project to high extent based on old components will of course have a lower lead-time than a complete new product. Pulse meetings are regularly conducted within the team members. This should also be attended by higher management, with the intention to put extra pressure on the team, in early stages also take decision to stop or add resources. Respondent I

Physical prototypes are sometimes needed to take right decision, this is an expensive alternative. Could be a potential to use the "in-house" test & prototype workshop. Test should be conducted at early stages to benefit on the full-scale number of concepts. Test conducted only on one concept, to later find it is the wrong one is even more expensive. VCE GDP only allows one concept to pass the concept gate and enter the detailed development phase. While others "Toyota" is more willing to test several concepts until completion before putting into the detailed development phase. Respondent I

Strategy

TTM and lead time currently has a high focus on VCE, all included in the business strategy. However it cannot jeopardize the QCDF. Quality must always come first followed by Cost, and then it is time under Delivery. Last one is feature, customer value. In addition there is no reward system in place at Volvo, which gives no extra incentive to pass gates on time. Currently it's on the organization level to investigate what is needed to reduce the lead-time. To receive higher budget is not always precedence as there must be a weighted result of resources and budget. Volvo should look into a way to make priority on both projects level but also on functions, departments or employee level. A lot of time is wasted on resource leveling, (trying to measure time and resource needed), instead of solving the problem. (Respondent I)

Organization

A Business Opportunity Description (BOD) is created in the pre study. The BOD should give the background, describe threats and opportunities and suggest changes or addition to the product characteristics. A feeling is that it varies in steering control depending on what region issue the BOD. In Sweden it has a broader approach giving the team members creativeness to explore different possibilities, but this usually leads into more time spent at later stages. (Respondent I)

Knowledge

Volvo has always been good at solving problems that appears, but we have a long way to go when it comes to reuse what we earlier learnt. There is the white book, as a diary documenting the work. The knowledge learnt from earlier experience needs to be systematic, logical and easy to access. It is here where Volvo needs to improve.

There is best practice to some extent, but only within project office members in Eskilstuna not across the different regions. The background of our project members varies from skilled to recently graduates, from consultants to permanent.

A well-known problem is shortage of skilled resources. Often key personnel are occupied with other tasks or other projects. Hire or use consultants and insert where needed might be a good solution. However this usually results in longer start up phases, as new members needs to understand and get informed about the ongoing details. To conclude, cash and time, is not the bottlenecks today at Volvo. (Respondent I)

Lack of resources would still lead to longer lead times. Another angle has been to outsource, that should not be a solution as the time spent to understand the culture and way of working will on the contrary lead to longer lead times, at least in the early stages. Instead our main disadvantage is lack of skilled employees and knowledge within the organization. (Respondent I)

Interview Respondent II

Strategy

Volvo has a clear strategy that has been channelled throughout the organization – to reduce the average project lead-times.

The process used is GDP, in addition supporting processes are in place or about to start;
CLIP – Cut Lead time in Project, which is a newly started project that focuses on reducing lead times in different activities from our line functions during the product development phases.
And to have a clear ownership of responsibility.
Project Pattern – Template to apply on projects (classification A to D), classifications based on volume, cost, complexity, NC (New Content) prediction
Based on best practice
Used as a baseline in the project, to get the estimated time the project should take.

Organization

The input to the projects is through the BOD (Business Opportunity Description). This input is provided from different functions in our organization from Marketing to Aftermarket.

The lead-time is measured from concept study gate to release gate. And despite the fact that the measure should be the same for all development sites, it is clear that it is not the case. Korea is often referred to as the most effective site, but as far as we know it has not been studied that the sites work are comparable in that sent. It may be a culture aspect to consider as well.

A way to tune the lead-time is to spend more resources in the pre-study. But this would not reduce the overall lead-time.
The GDP is the main process used for product development. When it comes to reducing lead times it's an inflexible tool to meet and reduce lead-times, the deliverables we have are inflexible and therefore it is tough to meet deadlines.

Steering committees survey and decide if a project is allowed to pass the different gates. What are to be delivered is decided before the project starts. They do not possess the detailed knowledge and do not need to. Committee members consist of Vice Presidents and Directors from all line functions.

What causes delays in projects varies, but when it comes to resources, the line functions supporting the project could be occupied with several projects at once, or the right competence (knowledge) is missing.

Another delay is caused due to the plain size of our organization; questions raised travel up in the organization until it reaches the right level allowed to decide. Also the several reorganization structures that have been performed causes early delays when trying to understand who owns a "problem" question.

Knowledge

The project team varies from senior members to newly appointed. Also there are currently a lot of consultants involved and a risk is when these are placed in key positions, they take knowledge with them when they leave. There is no common platform where knowledge can be shared and spread among the members or organization; this is a risk in Volvo as there is a lot of knowledge on the individual level in our organization. Today the knowledge is spread through cross functional meetings, overhearing or through the structural organization.

While Volvo through their size of organization could use knowledge through different time zones the risk is to have the project members decentralized which would need an excellent process to share information and knowledge.

A project should also report the progress in white books. This should function as a relevant lesson to the organization and to roles involved in the project. Unfortunately it is not a systematic or easy to extract needed information.

To care, tender and systematically collect knowledge for easy access to all, is a key to improve our product development. For this to gain focus in Volvos organization it must be possible to measure how the use of a systematic knowledge base would lead to improvements in the development and of course the reduction of lead-times. Until a reliable and valid measure is available it would be hard to convince the organization to add resources to this.

It must also be easy for functions, individuals to understand who owns a question, so it can be addressed immediately and avoid unnecessary delays. At the same time the concerned function

needs to be involved so a decision made on higher levels are possible to adopt/implement for the concerned function.

Interview Respondent III:

Strategy

Volvo has a high focus on time to market, reduce Lead-time strategy is today on high level, but work is currently being performed to anchor it deep into the organization.

The main process we use is GDP and supporting processes are;

CAST (Common Architecture Shared Technology), new process thinking with focus on common modularity.

CLIP – Cut Lead-time in Project – focus on lead-time in new product projects, parallel working, and cut lead times in actives performed by line functions.

Project Pattern – Template to apply on projects (classification A to D), classifications based on volume, cost, complexity, Reliability Growth prediction. Developed through best practice. Used as a baseline in the project, to get estimation on the time the project and different line functions should spend.

While project office in Sweden combine the component development into the product development project. It could be that the product in Korea has more shared components and therefore have already tested components in place.

Organization

Lead-time is measured from concept study gate to release gate, no monetary or bonus system in place today for finishing in time, and cannot see the benefit.

There is a feeling not all product lines use the same work methodology despite measuring the same gates. We believe Korean site already has the component development in place "tested components" before applying into the product development projects. Sweden site combine the component development the product development project. This results in shorter lead-times from the Korean site. It could be that the products in Korea have more shared components and therefore have already tested components in place.

In order to reduce lead-time focus should be on centralization, common technology should be shared, but the actual development and decision making for the specific product should be centralized to create expertize in the field and facilitate the knowledge sharing. Centralization will also shorten the decision lead-times.

Sometimes projects can be put “on hold”, usually due to budget/prioritization/head count. – Decision will be taken on platform levels.

Decisions from Gatekeepers (steering committee) are based on the information from the project leader and from the experience of the steering committee members.

Number of gates might be reduced or increased; today they are mainly classified depending on size of budget, more consideration to the complexity of the product is needed.

Resource issues in the line functions are raised due to several projects on-going at once, and sometimes due to lack of experience, new employments, swapping jobs. One solution is to utilize the organizational size to ask for assistance from other regions/time zones. However this somewhat contradicts the centralization thinking, so transfer of information and knowledge is fundamental to gain efficiency.

The input to a new product development - BOD (Business Opportunity Description) is provided based on needs from our line functions. These specifications may have detailed specifications due to standards or legal requirements; otherwise it can be very detailed or very vague. The different stakeholders (line functions) in the project team are involved during the full duration over the project.

Knowledge

Best Practice is used through “white books”. These are general description, no systematic solution. Improvement is needed on the utilization of white books, instead best practice is through mouth-to-mouth – therefore the benefit of centralized departments.

The individual expertise could be better maintained and shared, no good practise today in place to absorb and share the individual expertise.

It is also crucial to introduce new employees into the Volvo culture, a need of mentorship could be a solution.

The knowledge within the teams varies from consultants and new employees to experts.

Usually the organization encourage the project team members to continue in the same constellation in all projects.

Interview Respondent IV

Strategy

There is a strong long-term strategy to support reduction of average project lead-time, but there is also some thoughts under the strategy slogan "One common vision, one commonality" – Important not to forget that we are a global company and we need to adapt to the needs not only to customers but also organization and staff so the full potential is used.

Volvo has difficulties in keeping skilled personnel, current generation more eager to move around within an organization or to other companies. Raise the awareness of Experts within the organization through clear strategy, not only a status lift to keep them on same level as upper management but also to compensate them equally. This could result in more proud of staying longer.

Organization

There are huge tasks in front of the organization in order to align into a front load activity. Resources should be mobilized at an early stage of the product development phase, so all risk are clearly mapped and identified and all functions know what is demanded from them. Changes at later stage will increase inefficiency and stress resources.

Whenever discussions are raised to reallocate resources between existing project it is crucial to visualize the dilemma so all stakeholders understand together and take a joint decision in reallocation.

Machine and component development must align and run in parallel not to wait for each other.

Implementation of Result Based Product Modeling (RBPM) – instead of asking just for resources you ask for a specific solution.

Organizational cultural differences are also to be considered, some parts are very flexible when it comes to working hours and overtime.

Knowledge

Maximize the capacity of the knowledge within the company and put the right level of experience only where needed. For example a less complex task should not occupy the expert and guru. Today difficulties are that there is a wider base of junior than senior competence in the organization.

Understand why delays and late deliveries to other functions and implement corrective actions.

Not only the in house knowledge is crucial but also third party supporting functions such as supplier. Having a supplier close by who can easily attend physically to get feedback or instruct will facilitate the knowledge transfer.

When it comes to transfer of lesson learned one tool is the white book used where project management team review earlier project works. Unfortunately it focus too much on what has worked “bragging” instead of the pain sharing, what went wrong.

Experience is more important than the white book, not everything can be learned from a book.

Interview Respondent V

Strategy

The organization has a strong strategy focus to reduce project lead time. The focus should not negatively impact cost or quality instead it should be reached through increased efficiency. Challenges will be too effectively utilize the resources and know how already in place today.

Also strategy is on Product planning – to position for the future, and have it aligned with component plans. Main challenges to secure technical solutions in time for project launches.

Organization

The size of the organization can result in ineffectiveness, but there are activities ongoing such as lean management to reduce waste and frontloading activities. For example previous resources have been distributed evenly throughout the project. Now a more frontload approach is being implemented, that is strongly supported from top management. The idea is to overcome later changes in the project if solutions can be established early on.

The hierarchical levels in VCE organization facilitates decisions lead time. With exceptions when concepts/components are between two line functions – who owns the component solution?

Knowledge

Start Of Production (SOP) today has a strong hit rate meeting deadlines, unfortunately at the expense of product cost. Gates deadlines are not always met, could be solutions not in place, and committees or the project team do not allow/recommend to continue.

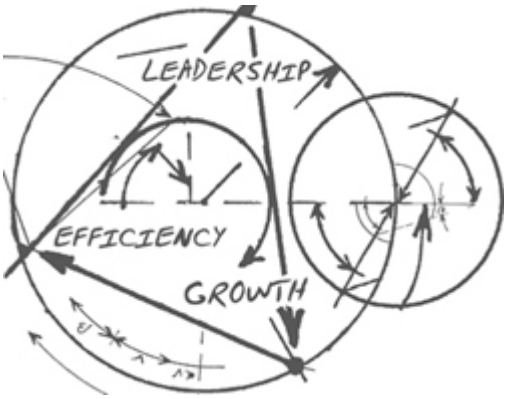
The size of the organization also complicates it when it comes to teams that are spread out in the organization – how to handle the spread in the organization? Meetings needs to be scheduled and organized to share experience/plans/knowledge – this takes additional time from the daily work instead of easy access to colleagues.

Today there is no structured way to share best practices / knowledge. White books are used but it is not a structured way to share knowledge. They should be short and easy to understand. Instead there is a very good internal communication “overhearing”.

Individual knowledge is really important. It is vital to our results that expertise is encouraged and premiered. Volvo CE needs to nurture and take care of the individual knowledge and not lose it in the process thinking.

F – Volvo CE Strategy 2013-2015

The Volvo CE strategy 2013-2015 is based on nine key focus areas and nineteen strategic objectives. By succeeding in these areas, Volvo CE and the Volvo Group will take a step nearer their wanted position in 2020. (Click on the image to download the logo):



Below you will find the nine key focus area and the strategic objectives within each of them.

- Key focus area no. 1
  Profitably grow SDLG business globally
  Strategic objectives
  1.1 Achieve significant increase of excavator share in Chinese market (X%)
  1.2 Grow export business to XXX units
  1.3 Grow Customer Solutions export business
  1.4 Operating margin and positive cash flow supporting the overall targets

- Key focus area no. 2
  Develop Volvo branded products for emerging markets
  Strategic objectives
  2.1 Develop emerging market products to QDCF targets with greater focus on design to cost and time to market

- Key focus area no. 3
  Significantly increase Customer Solutions revenues
  Strategic objectives
  3.1 Increase Customer Solutions revenues by XX%
  3.2 Increase Customer Support Agreement penetration to XX%

- Key focus area no. 4
  Significantly increase dealer & supply chain capability
  Strategic objectives
  4.1 Develop dealer capability to support targeted revenues
  4.2 Ensure Volvo CE assembly and supplier capability for targeted revenues
  4.3 Achieve XX% delivery precision from our suppliers and to our customers

- Key focus area no. 5
  Increase share and profitability of Road products
  Strategic objectives
  5.1 Achieve rank 1 or 2 in key Road products and significantly improve market share in

each region
5.2 Provide a portfolio of competitive Road products designed to cover XX% of Road machinery market

- Key focus area no. 6
  Increase gross margin per machine
  Strategic objectives
  6.1 Average hard product gross margin XX%
  6.2 Achieve average cost reduction targets of X% across existing range

- Key focus area no. 7
  Increase product portfolio development (PPD) efficiency
  Strategic objectives
  7.1 Reduce average project lead time to 24 months
  7.2 Reduce claims per machine to average XX

- Key focus area no. 8
  Deploy CAST globally (Common Architecture, Shared Technology)
  Strategic objectives
  8.1 Implement modular architecture and CAST technical solutions as per roadmap to achieve full CAST deployment by 2017

- Key focus area no. 9
  Develop, recognize & promote excellent leadership
  Strategic objectives
  9.1 Achieve high performing levels of employee engagement
  9.2 Achieve a 20-point improvement on the following two specific survey questions: PBP Quality & Leadership the Volvo Way