CHALMERS

Implementation of Visualization according to Lean Product Development

- A benchmarking analysis and recommendations for implementation at Mölnlycke Health Care

Master of Science Thesis in Quality and Operations Management

PETER AXEBORN

LISA BJUGGER

Department of Technology Management and Economics
Division of Quality Sciences
CHALMERS UNIVERSITY OF TECHNOLOGY
Göteborg, Sweden, 2011
Report No. E2011:077

Implementation of Visualization according to Lean Product Development

A benchmarking analysis and recommendations for implementation at Mölnlycke Health Care

Master of Science Thesis

PETER AXEBORN & LISA BJUGGER

Department of Technology Management and Economics
Division of Quality Sciences
CHALMERS UNIVERSITY OF TECHNOLOGY
Göteborg, Sweden, 2011

Master Thesis – Implementation of Visualization according to Lean Product Development- A benchmarking analysis and recommendations for implementation at Mölnlycke Health Care

Technical report no E2011:077 Department of Technology Management and Economics Chalmers University of Technology SE-412 96 Göteborg Sweden Telephone + 46 (0)31-772 1000

Göteborg, Sweden 2011

Chalmers repocervice

Göteborg, Sweden 2011

Abstract

This thesis was initiated by Anders Karlsson, Global Quality Manager R&D, Mölnlycke Helath Care (MHC), in order to improve the product development processes at MHC. After a pilot survey among 16 employees within MHCs product development organization the conclusions was drawn that the thesis should focus on improving the areas of communication and transparency. In order to improve these areas a decision was made to look deeper into the area of visualization according to Lean Product Development, LPD, and how it could be implemented. The Master Thesis was executed by Peter Axeborn and Lisa Bjugger from Chalmers University of Technology, during the spring of 2011.

To find best practices of how other Swedish companies have implemented visualization within their organizations, a benchmarking study was made. The study was made among five Swedish companies and two researchers in the area of LPD. The focus of these interviews was to learn from their experiences and to understand why and how they implemented visualization according to LPD. This benchmarking study is the heart of this report, and the results of it are discussed in light of relevant theory.

What has been concluded from the benchmarking is that there is no “best” approach when implementing visualization according to LPD. It is important to understand that you cannot copy paste from other companies, due to that each company is unique.

Parallel to writing the thesis, the findings from the conducted benchmarking study were used in practice to generate a visualization framework adjusted to MHCs needs. This framework was created together with a reference group within the organization of MHC, in order to help MHC to spread the knowledge and curiosity of visualization within the company.

Keywords: Visualization, transparency, communication, continuous improvement

Acknowledgements

We would like to thank our supervisor at MHC Anders Karlsson for guidance and great support throughout our Mater Thesis. He has helped us taking our thesis forward and has contributed with interesting discussions and inputs for a successful outcome.

We would also like to thank all interviewees at MHC who participated in the pilot study. Furthermore we would also like to thank Ingela Lundgren, Karin Henningsson and Camilla Johansson at MHC for participating in the reference group.

We also want to thank our tutor Lisa Carlgren and examiner Sverker Alänge at Chalmers University of Technology for feedback and guidance during our Master Thesis.

Last but not least we want to thank all involved in our benchmarking study: Stefan Bükk, Göran Bodlund, Marita Christmansson, Mats Espling, Sam Gohari, Peter Palmér, Anders Svantesson and Björn Söderberg. Without your contribution the results of our Master Thesis would not have been the same.

Table of contents

1 Introduction

To survive in an ever changing market companies always need to focus on the customer and on value adding activities. This was something Toyota realized already after the Second World War, when Taiichi Ohno went to America to see how Ford produced their cars. He realized that Toyota needed to use their resources in a more efficient way to be able to compete with the Americans (Liker 2009). When Dr Allan Ward asked managers and engineers at Toyota how much of their time they spent at "creating value" or "creating knowledge" or "doing engineering work" they answered 80%. When he asked the same question to other companies in America they answered 20% and to other Scandinavian companies they answered 40% (Kennedy 2003). The reason why Toyotas managers and engineers are able to be as efficient is because of their PD process, which has through writings of American scholars become known as Lean Product Development, LPD (Ward 2007). LPD focuses on eliminating unnecessary tasks and activities which are not value adding for the customers. Communication and transparency are two important parameters in LPD when eliminating unnecessary tasks and activities (Liker 2009).

A common problem in many product development organizations is that vast knowledge is generated in the organization but it is not communicated (Alfredson & Söderberg 2009). Visualization according to LPD is one way to influence the communication within an organization. Visualizing in LPD includes everything from visualizing a product, a company's strategy, problems and improvement areas as well as visual planning, VP.

VP has been used in many different areas for a long time e.g. at kindergarten and in public hospitals, but in PD the work with visual planning has recently started (Espling 2011). What many companies today are doing is that one person, usually the project leader, is planning the whole project by himself according to a certain amount of time and different activities, this planning is often done in a Gantt chart or in Microsoft Project (Holmdahl 2010). He further argues that even though traditional project management focuses on time and budget often projects are delayed and exceed their budgets. This differs from the traditional way of project management, which is activity focused, since VP focuses on deliveries. By visually plan and communicate deliveries on a board everyone can easily participate in the planning, which encourage faster

problem solving and better possibilities to level out the workload (Oosterwal 2010, Alfredson & Söderberg 2011).

One success story of a company that has implemented the LPD concept is the American motorcycle manufacturer Harley Davidson. By implementing visualization and VP into their PD- process more aggressive development goals could be set. This could be done thanks to better communication and clarifying each employee's connection to the company objectives and highlighted issues in the PD-process (Oosterwal 2010).

Looking at the Swedish market the philosophy of Lean Production has been used for several years in production. About ten years ago Swedish companies started using the LPD philosophy in their PD processes. Stefan Bükk, Swerea IVF, argues that Swedish companies are in a leading position, compared to other countries, in their LPD work. Due to that Swedish companies are mature in their LPD work, many Swedish researchers have researched the area of LPD (see e.g. Ohlsson & Ottertun 2008, Alfredson & Söderberg 2009, Holmdahl 2010) among others. However all the literature concern the whole area of LPD. Only few have looked deeper into the area of visualization, which Holmdahl (2010) discusses as one of the first and most easy areas to start with for companies.

In order to target MHCs problems a pilot study was performed at MHC consisting of interview sessions with employees at MHCs PD department. This led to the conclusion that several employees were missing transparency and visibility within the organization. Based on these circumstances, it was decided that the thesis should focus on how visualization could help MHC increase transparency and communication in their daily work.

This, together with the problems regarding communication within PD organizations discussed among the authors above spurred the topic of this thesis to look more in depth into the area of visualization according to LPD and what is critical when implementing visualization in Swedish PD-organizations.

2 Purpose

The purpose of this thesis is to identify best practices when implementing visualization according to LPD in a PD organization and to relate these findings to the MHC context.

The knowledge gained from our study will result in recommendations for the implementation of visualization in MHCs PD organization.

2.1 Research questions

To be able to fulfill the stated purpose four research questions were defined, were the first research question provides the foundation for question two, three and four.

1. In what areas of the PD process can MHC improve their work in order to be more efficient?
2. How do companies in Sweden work with visualization in PD organizations?
3. What aspects are important regarding implementation of visualization in PD organizations?
4. How can MHC start an implementation of visual planning of their PD organization?

2.2 Problem definition and outline of the report

The thesis is divided in to six blocks: Introduction, Methodology, Literature review, Empirical study, Conclusions and Ongoing implementation at MHC and recommendations.

The empirical part is further divided into two parts. The first part includes the results from a pilot study conducted at MHCs PD department, where employees within the MHC PD department were interviewed in order to identify possible improvement areas. The conclusions drawn from the pilot study will answer research question one.

Part two consists of a benchmarking study of five Swedish companies and two Swedish researchers in the area of LPD. This benchmarking aims to find important aspects regarding what to visualize and how to implement visualization according to LPD in Swedish companies. Knowledge from the benchmarking study together with relevant literature will answer research question two and three.

Findings from the empirical study will form the base for recommendations to MHC of how to start an implementation of visualization according to LPD in their PD organization. Our recommendations are built upon discussions together with a reference group at MHC, chosen by our supervisor Anders Karlsson, and knowledge gained from the pilot and benchmarking study. This part will answer research question number four.

Areas that will be discussed are how to overcome learning anxieties involved when changing an organization and how to create an understanding for the need of visualization. We will also discuss how an implementation could start for example: if it should be a top down approach, when the management decides, or if it should be a bottom up approach, when the initiative is taken by the employees? When implementing visualization, should the entire organization start at the same time or can each team decide by themselves when and how to start? Moreover, should everything on the visual board be mandatory, regulated from top management, or can each group decide how their visual board should be structured?

2.3 Company Background

Mölnlycke was founded in 1849 as a textile company. In 1997, Mölnycke Health Care, MHC, was established as an independent company, separated from SCA. Today MHC is a global medical care company with approximately 7000 employees, which has grown rapidly the past 10 years. MHC has two different divisions, surgical and wound care. Surgical develops and produces single use equipment for surgery, such as face protections, gloves, cloths, drapes and antiseptic solutions. Wound care is focusing on developing and producing wound care products such as dressings, dry skin emollients and bandages. MHCs main customers are hospitals and district health care centers worldwide. One innovation which MHC is most known for is their Safetac technology, which is a silicone based glue used on different types of dressings which makes the removal of a dressing less painful for the patients (Mölnlycke 2010).

2.4 Delimitation of study

The time frame of a Master Thesis is 20 weeks, something that needs to be taken into account when the scope is defined. Due to the time frame this thesis will only focus on MHCs PD organization, both surgical and wound, and the possibility to improve their efficiency through visualization.

In terms of the literature study, relevant areas chosen are communication within organizations, visualization in PD and implementation & transformation. Concerning the LPD area, a general description about the LPD concept is given, but focus in this report is on visualization and communication within R&D.

In the conducted benchmarking study, a choice has been made to only look at Swedish companies that have worked with visualization according to LPD for some years. Due to the timeframe we chose to limit the benchmarking scope to five companies and two researchers within the area of LPD.

2.5 A few notions

For ease the reading of this thesis some recurring concept will be defined and described hereunder.

KPI- Key Performance Indicator

LAMDA- Look, Ask, Measure, Define, Analyze

LPD- Lean Product Development

MHC- Mölnlycke Health Care

PDCA- Plan, Do, Check, Act

PD- Product Development

PICK- Possible, Implement, Challenge, Kill

QA- Quality Assurance

Visualization- Visualization is a wide area and can be perceived in many different ways. In this thesis visualization is referred to as a method used in LPD. It includes all kind of visual communication within an organization, and can for example be: visualizing a product, a company's strategy, problems and improvement areas as well as Visual Planning

VP- Visual Planning is one tool used in the visualization method according to LPD, where planning is done visually on a board

3 Methodology

3.1 Research approach

This thesis is made in collaboration with the organization of the PD department of MHC. According to Argyris et al (1985) a research approach where the researcher works in collaboration with a company is referred to as action research. Action research can be seen as an iterative process where the central elements are identification, planning, action and evaluation. Further, the outcome of action research often results in improvement suggestions and changing the way people think and act. But it should also contribute to the academic theory (Bryman & Bell 2007).

When collecting data it could either be done with a qualitative or a quantitative approach. Quantitative data collection is characterized by measurable data and statistical analyses, whereas a qualitative data collection is usually more open, focusing on emotions and how the interviewees perceives a situation (Bryman & Bell 2007). In this thesis qualitative data was collected through face-to-face interviews. Interviewing as a method was chosen because it gave us the possibility to interpret emotions of how they perceived the philosophy of LPD and to ask follow-up questions which gave us a more in depth data. Sending out a survey would maybe have given us a broader spectrum of participants but at the same time there would have been a greater risk for them to misunderstand and misinterpret the meaning of the questions.

Furthermore Bryman & Bell (2007) argue that there are two main research approaches to use when doing a research, inductive or deductive. An inductive approach is when the researcher starts with collecting data from observations or findings and later uses theory to understand these finding and observations. A deductive approach starts with what is theoretically known within a certain field, which the researcher tests empirically with a hypothesis. It is also possible to combine these two approaches, which is called an abductive approach. It means that iterations are made between an inductive and a deductive approach. This thesis will have an abductive research approach, since it started inductively with a pilot study where improvement areas were defined and thereafter a literature review was made. With knowledge from the pilot study interviews together with findings from the literature research questions were created and a benchmarking was conducted deductively. In parallel with the

benchmarking study new literature was reviewed. Results from the pilot study at MHC, the benchmarking study, together with the revised literature review a visualization framework was created for MHC.

Also the ethical issues have to be taken into consideration in this thesis. The Ethical issues that might be of concern will mainly be related to the areas of "deception" and "lack of informed consent" (Bryman & Bell 2007). It is therefore important for the researchers to clearly state for the participants what will be done, how the study will be conducted and how the findings will be used.

3.2 Literature Study

In order to connect our findings to previous research we chose to review literature in the areas of communication within organizations, visualization in PD and implementation & transformation. These areas were chosen after conducted pilot study where communication and transparency were identified as improvement areas. One way to increase the communication within organizations is to work with visualization according to LPD. To understand how an organization could improve their communication through visualization literature within the areas of communication and visualization were reviewed. To gain knowledge of how an implementation of visualization in a PD organization could start, and what critical factors have to be taken into consideration literature regarding implementation & transformation were also reviewed. Literature used in this thesis was systematically searched or advised from interviewed people within the LPD area and gathered from articles, books, E- books and other Internet sources. To make it possible to have an overview of all reviewed literature, an Excel document was created where a short summary of each source was made.

3.3 Data Collection and analysis

3.3.1 Pilot Study

The first part of this thesis was made as a pilot study to get familiar with the organization and to find possible improvement areas in MHCs PD organization. No literature was reviewed in advance in order to be as open minded as possible. In the pilot study 16 persons form the PD organization were interviewed. Functions involved were eight Product designers, four Product owners and four Managers. All interviews were made as semi-structured face-to-face interviews where the interviewees were able to

speak outright, see Appendix 1. By letting everyone speak freely we could more easily identify which improvement areas the interviewees felt were important to them. As Bryman & Bell (2007) recommends qualitative data is more applicable when gathering emotions and interpretations when collecting data and therefore this method was used in this thesis. During the interviews one person was leading the interview and the other person were taking notes and observed the interviewees reactions to be able to gather all impressions from the interviewees. In order to prepare all participants in advance an E-mail with the main subject of the interviews were sent in advance. Each interview was recorded to make it possible to review if there were any vagueness regarding what was said during the interview and to be able to focus more on the interview rather than taking notes.

After each interview a summary was made, and if needed recorded material was reviewed. Data collected from the pilot study survey was later analyzed in a KJ- Shiba brainstorming session, in order to find out how different areas are linked and how they affect each other. The KJ method can be compared to a structured brainstorming session for problem solving (Shiba 1987). The aim of the KJ method is to in a structured way organize facts around a problem/issue where there are many different opinions. It is a brainstorming method that uses post-it's to structure and organize loose and unstructured ideas. These ideas can come from a brainstorming meeting as well as from collected data. It forces the group to focus on the task at hand and is helpful at eliminating unnecessary discussions and distractions from the goal (Shiba 1987). For a deeper description of the different steps to conduct a KJ- analysis, see Appendix 2.

3.3.2 Benchmarking

In order to gather knowledge of how other Swedish companies are working with visualization and what has been important when implementing visualization according to LPD, a benchmarking study was conducted. In our study five Swedish companies and two researchers in the area of LPD were interviewed. These companies were chosen because they represented the leading companies in the area of LPD in Sweden according to recommendations by researchers and experts in the area. All involved companies are global and have worked with visualization according to LPD for at least a couple of years. We also chose to interview two

researchers in the area of LPD. This was done in order to learn from their experiences regarding implementation and visualization work according to LPD in other companies.

All benchmarking interviews were conducted in the same way as the pilot study. Two different interview guides were used for the semi-structured interviews, one for benchmarked companies and one for interviewed researchers, Appendix 3. After each interview a transcription was done. An Excel document was created, in which all questions asked during the interview were stated. The transcribed material was reviewed and key data were chosen in order to synthesis the status of LPD visualization techniques in the companies. Based on this, implementation suggestions were created for MHC through discussions with our supervisor and a reference team at MHC.

3.4 Other sources of information

3.4.1 Reference team

In order to make this thesis as valid as possible for MHC and to build in the knowledge gained from the benchmarking study, a reference team was established within the company. This was made as a so called collaborative research approach where members from the organization actively participate in the research process and also benefit from the research (Bryman & Bell 2007). In parallel with our thesis initiatives had already been taken in some groups at MHC to start working with visualization according to LPD. Managers from three of these groups were dedicated to become members of our reference team, each one of them responsible for one line function.

To start the work with the reference team, a start up meeting was held, were findings from benchmarked companies and researchers where presented. To get them involved in the process of creating a visualization framework, everyone was asked to sketch a simple picture of what they thought was important to visualize. With this picture and findings from our benchmarking we started to create a visualization framework for MHC. To make progress in the process weekly meetings were held for six weeks with the reference team in order to get their inputs. These meetings were held during six weeks, starting after the completed benchmarking study. All meetings were arranged as stand up meetings, according to the LPD philosophy (Holmdahl 2010). These meetings were kept as short as

possible, maximum 30 minutes. During each meeting a draft of what is possible to visualize were presented by us. Everyone was able to give inputs and all ideas were taken into consideration. These thoughts were later reviewed and a new draft was created until everyone was satisfied. The generated framework will also be used as an education material for spreading the visualization knowledge within MHC.

3.4.2 LPD course

During this project we got the opportunity by Stefan Bükk, Swedish researcher within the area of LPD, to participate in a three-day LPD course. This course was facilitated by Stefan himself and Lars Holmdahl, also author to the book "Lean Product Development på Svenska", which has been used in this thesis. During the course discussions regarding how Swedish companies are working with LPD and visualization according to LPD were held. This gave us a lot of useful data and knowledge for further thesis work at MHC.

3.5 Reflections of used methodology

When the thesis was initiated the aim was to define possible improvement areas where quality tools could be used. But after conducting the pilot study and with the results from the KJ- Shiba in mind, the aim was changed to LPD in general and visualization according to LPD in particular. If the aim from the start would have been to look into visualization according to LPD, then maybe another spectrum of employees could have been interviewed at MHC. This change of aim also created some problems with finding a suitable reference team at MHC that were interested in and had knowledge about visualization and were able to put in the time needed for our Master Thesis.

In terms of conducted benchmarking, more companies could have been benchmarked to support this thesis with even more reliable data. But regarding the time frame of the Master Thesis a decision was made to only benchmark five companies and two researchers in Sweden. We felt that we got a useful spread and variation of how different companies have started their implementation of visualization. What could have been done better in the beginning of the benchmarking was to be more eager to see different kinds of visualization boards and also to take photos of them. By doing this we could also had gained more valuable information about how frequently each board was updated and if they were used as the

interviewee told us. This was something, which we emphasized more later on, which made these interviews more valid for our study. We also felt that during the interview study we became more comfortable interviewing and where thereby better at asking the "right" follow up questions.

Another reflection that we have made after all interviews is that we maybe should have spoken to more people working actively with visualization, this would have given us a broader picture of how they reality looked like. The interviewee's could be seen as expert users in the area of visualization. In two of the benchmarked companies we accidentally meet two employees that used visual planning in their daily work. By speaking to these users they reaffirmed what the interviewees had mentioned.

One area that we in the beginning tried to improve was the area of global visualization and how MHC could work according to LPD. Unfortunately the benchmarked companies did not have any good examples of how to solve this. If we would have emphasis to find companies which worked more globally with visualization, then our recommendations for MHC would have been even more valid.

Due to that the fact that the literature regarding implementation and transformation of LPD initiatives in Swedish companies was a bit sparse, we hade to use literature written by non Swedish authors and thereby reflect upon cases outside Sweden. This could affect the reliability of this thesis, due to that there are cultural differences between Sweden and other countries. However we think that knowledge gained from the benchmarking of Swedish companies and researchers together with the international literature studied resulted in profound recommendations to MHC. This due to that our conclusions are based on both hands on experience from Swedish companies and non Swedish literature.

Regarding the literature reviewed in the area of implementation and transformation we now, after conducted study, feel that this area was not taken into consideration enough during our benchmarking study. We should have put more focus in the benchmarking study to understand what had really failed with their implementation and how they had act upon these failures. One of the reasons to why we did not go into detail in this area was because the spread in our thesis and due to the tight time frame of the thesis. We choose to look into three main areas; pilot study, benchmarking and implementation, which each could have been one

master thesis each. But due to that our MHC supervisor emphasized that it was important for the company to look into all three areas in order to really see if our findings actually could be implemented in the PD organization at MHC. Taking this into consideration we still succeeded to transform this thesis into something valuable both for the academic world and for MHC, since much of our recommendations in the epilogue is now either implemented or are an ongoing work within MHC.

4 Literature review

The literature review focuses on understanding how communication and transparency can be improved through support from LPD visualization methods. To understand this, Communication within organizations starts this literature review and later continuous with Visualization in Product Developments and finishes with Implementation and Transformation.

4.1 Communication within organizations

The complexity of today's products and services creates bigger demands on project management in the area of communication and transparency. One way to target these problems is discussed by Kennedy (2003), where he argues how knowledge based PD according to LPD can facilitate communication and transparency within an organization. LPD is about capturing and using knowledge within an organization. Kennedy describes the knowledge transfer as two different arrows, one knowledge value stream arrow and one project value stream arrow, horizontal axis, Figure 1.

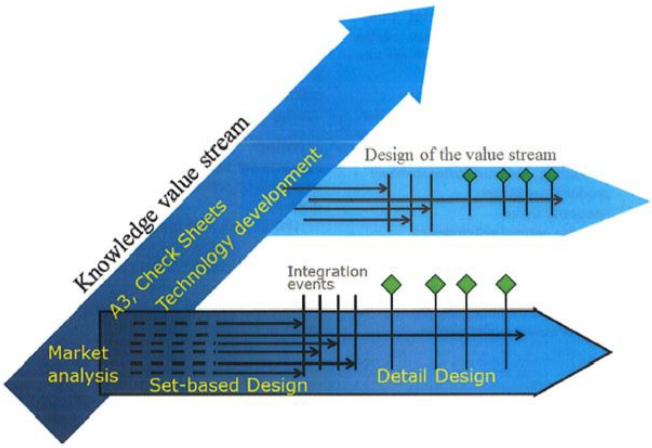

Figure 1, Kennedys Knowledge Value Stream

What he wants to achieve with this way of explaining knowledge transfer is the importance of communicating knowledge from employees into the organization in order to learn from previous projects. To achieve this, transparency in the organization and between employees is needed. According to Nonaka (1994) there are two types of knowledge, Tacit and Explicit knowledge, where Tacit knowledge is the knowledge that you learn by heart and is hard to explain e.g. to learn how to ride a bike. When you learned to ride a bike you just do it, but it is very hard to explain how

you do it. Explicit knowledge is knowledge that you can achieve by reading or just listening to another person (Nonaka 1994).

Dow & Taylor (2008) argues that communication in projects and organizations includes the processes required to ensure appropriate generation, collection, distribution, storage, retrieval and disposition of information. To do this LPD philosophy could facilitate communication flows e.g. through A3 reporting and short stand up meetings.

4.1.1 Communication ways

There are different ways to communicate within companies, for example there are formal and informal ways to communicate. Formal communication is often written down and impersonal and is the kind of information that is given at meetings and other formal company gatherings. This information can be found in documents, presentations and reviews. Informal communication is often more personal and given in ad-hoc conversations for example at coffee breaks and is usually perceived as less accurate and less credible information because it is not "black on white" (Müller 2006). This is important to take into consideration when spreading any kind of information and is crucial in change processes. Further it is also important to consider the internal and external communication in a company. There are differences between internal communications within a group compare to external communication to the whole organization. Due to this the visualization can be adjusted to the communication needs.

Other aspects to consider when communicating are the up-stream and down-stream as well as horizontal communication in an organization (Wheelwright & Clark 1992). The language used should be adjusted to the appropriate level so that the receiver of the information understands it. In up-stream and down-stream communication different departments and levels of a company have to communicate, therefore the same language has to be used. For example when the IT-department communicates with purchasing no internal IT-terms may be used or vice versa (Müller, 2006).

4.1.2 Managing communication

There are different ways to communicate in an organization. Müller (2006) mentions three main ways to communicate: verbal, written and visual. It is important to be conscious of how to communicate and in which ways and

how the receivers will interpret it. It is also important to differentiate between who owns, communicates and receives information in an organization and when it is communicated in order to get the message through. One method to facilitate these different information owners and receivers is to for example visualize clearly on a board when communication should be done, who owns the information, what kind of message it should contain and through which channels it should be sent.

4.2 Visualization in Product Development

Visualization is a method used in LPD in order to enhance communication and knowledge transfer. Alfredson & Söderberg (2011) argue that the brain more easily can process images than text, and that it is therefore easier for people to communicate visually instead of only communicating in written text e.g. through reports. The area of visualization is wide and can be done in many different ways. The areas that this thesis will cover are visualization according to LPD i.e. Visual Planning boards, improvement boards, visualization of goals and strategies and A3 reporting. As an introduction we will go through the basics of LPD and then further continue with how you can visualize according to the LPD philosophy.

4.2.1 Lean Product Development

Since the beginning of the 1990s visualization according to Lean has been a common expression in production. The term Lean was presented for the western world by Womack et al (1990) in the American book "The machine that changed the world", which explains the Japanese car manufacturer Toyotas effective way of producing cars with high quality and to an affordable price. When the General Manager for Toyota North America was asked why Toyota has not written any literature about their processes, he reflected and after a few minutes he answered *"It is because it would only be one page, saying: Keep it simple, make it visible, and trust your people to do the right thing"* (Ohlsson & Ottertun 2008 p.10).

This is in short terms a summary of what Lean is all about. The past ten years this philosophy has been transformed also into the PD- process, and is today more known as LPD (Kennedy, Harmon & Minnock 2008). There

have been some rejections against the philosophy in many companies. Some people argues that the method only is suited for Asian car manufacturers and is not possible to use in other companies (Kennedy 2003). Take for example the American motorcycle producer Harley Davidson, which implemented LPD and increased their efficiency six fold (Oosterwal 2010). Womack et al (1990) argue that the reason to why Toyota is so successful is not only because they have a great production system, it is also due to their company culture that affects everything they do. The authors further argue that LPD is a sociotechnical system, a system that is build up by processes, people and tools. To gain advantage from LPD an organization must understand the interrelations and correlations between these different parameters.

To define what is value adding for the customers and to understand what is not value adding, waste, in the PD process is crucial. What differs from Lean production is that waste in LPD is not transportation of goods between different manufacturing processes. Waste in PD is more about poor communication and non-value adding activities, such as unnecessary long meetings. At Toyota the communication is central and the system is built up so that it is easy for everyone, at every level, to find important information. This is something Kennedy (2003) discusses, he argues that the communication at Toyota is not forced; it is the system that is facilitating good communication.

Through good communication which is gained from visualization among others, Toyota has been able to front load their processes. Front loading, see Figure 2, is when you allocate recourses in the beginning of a project in order to avoid late changes and quality problems close to release date, which also decrees the costs. To front load the PD process as Toyota does can seem time consuming. But the fact is that Toyota has both a faster time to market than their competitors and lower cost of their changes (Morgan & Liker 2006, Petersson 2011).

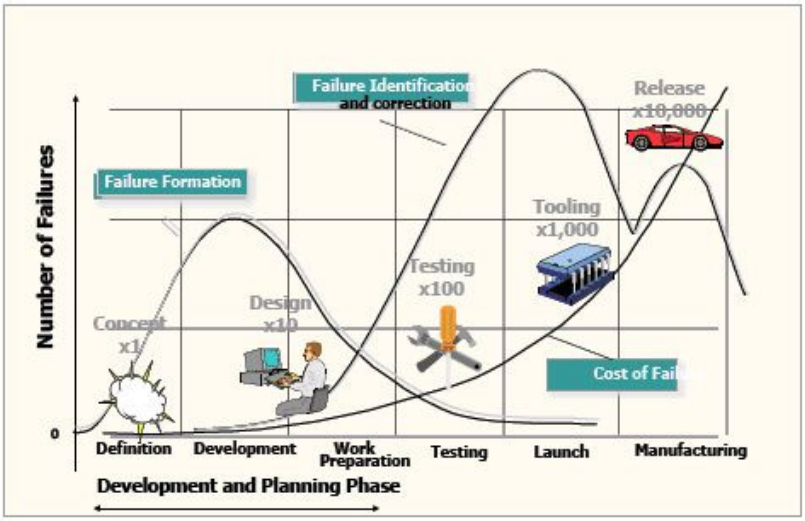

Figure 2, Cost of a change

To facilitate a front loading way of working, Toyota early emphasizes and visualizes common goals and strategies of the project. They also use Visual Planning, VP, to facilities the communication within the team. By working in this way everyone becomes involved and understands better in which direction a project is heading, which also facilitates faster problem solving (Oosterwal 2010, Alfredson & Söderberg 2011, Holmdahl 2010, Liker 2009).

4.2.2 Visual Planning

When starting implementing LPD in Swedish companies, the first step to take is to implement Visual Planning, VP, (Holmdahl 2010). The reason why companies have implemented VP is that it is a rather easy tool to implement in an organization and is easy to understand for people and it enhances the communication (Alfredson & Söderberg 2011, Oosterwal 2010).

VP is an efficient way to easily plan activities visually on a board on the wall instead of for example using an IT-system. Toyota is using something that they call *Obeya,* it is japanese and it infers to "big room". At Toyota it has become a project management tool, used especially in PD, to enhance effective and timely communication. An *Obeya,* or project room, usually contains VP boards, graphs, milestones, progress boards and countermeasures to existing timing or technical problems (Morgan & Liker 2006). VP boards are used to visualize planning, which is divided into different areas. Often it is built-up as a matrix where the columns

visualize the team members and the rows visualizes time, and is divided into short term-, mid term- and long term planning. They could also be built up with line groups versus projects, which visualize the correlations between them to support the cross- functionality between these two groups. Cross-functional boards also encourages communication both upstream and downstream between different business areas e.g. between PD and production (Wheelwright & Clark 1992). Figure 3 is an example of a short-term schedule, divided into two weeks. Different form a Gantt chart where the focus is on the activities, VP focuses on deliveries and recourse availability and how to use them as effective as possible (Holmdahl 2010).

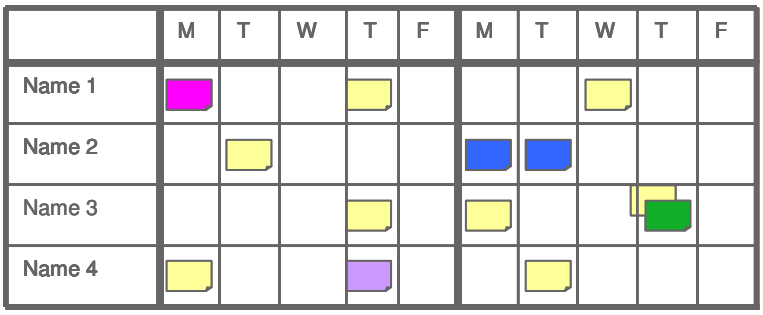

Figure 3, short term VP

To structure the planning on VP- boards, post-its are often used. One post-it represents one delivery, which is put up by the responsible person on his or her row. To make it even more visible and easier to follow the planning, different colors could be used, as seen below in Figure 4 (Peterson 2011).

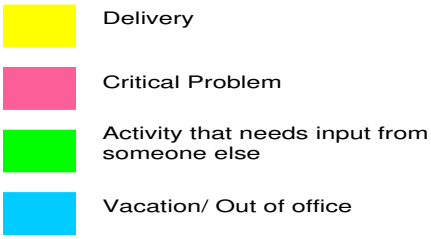

Figure 4, Color code (Peterson 2011)

When a delivery has been executed, the post-it is removed or a red cross is made in order to visualize the progress. If a delivery is delayed, for some reason, a red dot or a red dotted line is drawn around the post it and afterwards this post it is moved to a new position (Holmdahl 2010). This makes it easy for everyone in the group to understand problems and issues. It will also encourage team members to contribute with own solutions and

improvement suggestions. VP also encourages the possibility to solve problems earlier and faster, due to that the information needed is visual, updated regularly and accessible for everyone. (Holmdahl 2010, Alfredson & Söderberg 2011). Alfredson & Söderberg (2011) further argue that VP also helps the managers to easier prioritize among projects and deliveries, because everyone in the team is more involved and contribute to the planning.

Moreover, another effect of VP is the stand up meetings which are held in front of each board. Through these stand up meetings, shorter and more effective meetings, usually up to 15 minutes, are held where everyone in the team participates (Holmdahl 2010, Alfredson & Söderberg 2011). Before each meeting the members update their status on their row so that the information is valid at the meeting. Alfredson & Söderberg (2011) further mentions that during the meeting, each member goes throw their deliveries and if they have any problem. The meeting is facilitated by the responsible for the VP- board, usually the team- or project leader (Alfredson & Söderberg 2011). One important parameter of VP is that the people involved have to go to the board and do the changes. To do this in front of your colleagues empowers you to feel more responsible for the task and to deliver when promised (Ohlsson & Ottertun 2008, Morgan & Liker 2006).

In the Lean literature all authors talk about eliminating *muda,* which means waste. Waste refers to all activities that are not value adding for the customer (Peterson 2011). VP it is not only about focusing on eliminating waste, it is also about eliminating *mura*, unevenness, and *muri,* overburden (Morgan & Liker 2006). They further argue that companies today are focusing too much on waste and on short time cost saving goals and forget unevenness and overburden that show more results in the long run. But it is important to use a combination of all areas above in order to see progress. By visually showing all deliveries it is also possible for a team to level out the workload together and by that eliminating the unevenness and overburden. Unfortunately this could also be one of the largest threats against visualization, the fact that people do not want to show what they are doing could be a problem (Morgan & Liker 2006).

4.2.3 Visualizing continuous Improvement work

As is mentioned above Toyota also visualizes countermeasures to existing timing or technical problems in their Project rooms. Continuous improvement, *Kaizen,* is a central part of the Lean and LPD philosophy. In LPD it is important to create an environment which facilitates improvements and makes people in the organization understand that it is ok to fail, but that you have to learn from every mistake (Ward 2007). Holmdahl (2010) argues that the fact to why Swedish companies succeeded so well in implementing LPD is due to our company culture. In Sweden it is acceptable to fail and lose your face, which could be a problem in many Asian cultures.

One tool commonly used in the purpose of working with continuous improvement is the PDCA- cycle. The PDCA- cycle was created by Deming (1986) and stands for Plan-Do-Check-Act, and is used in order to always work in a way that facilitates improvements. When an improvement is planned you start at Plan and then go through all stages until you reach Act, which is when the suggestion is implemented. As could be seen in Figure 5, the PDCA cycle could be divided into seven smaller steps to make it more comprehensible. One of the most important steps is number three, identifying the root-cause, in order to make a good analysis and create valuable improvement suggestions (Deming 1986, Ward 2007).

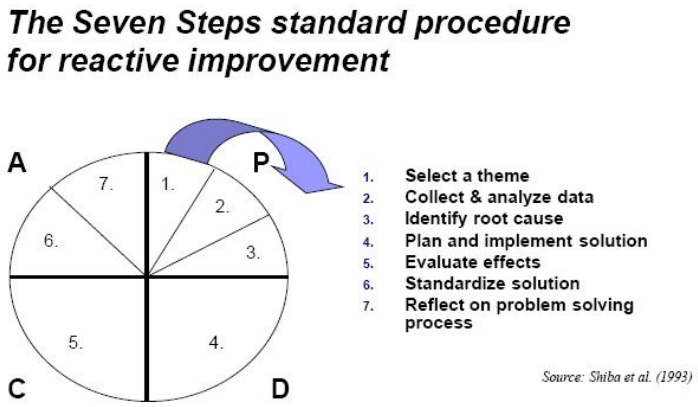

Figure 5, PDCA- cycle

Another way of visually showing continuous improvements is stated by Allan C. Ward, where he instead of PDCA uses LAMDA which is an abbreviation for Look- Ask- Model- Discuss- Act. He explains that in one

PDCA cycle there are two LAMDA cycles, see Figure 6 . Ward argues that Look and Ask is the two most important parts in this process. He means that you have to go and see to understand the problem before you can come up with a solution. Furthermore, Ward argues that western industries are focusing too much on the ACT part and on the final solution instead of getting to know in depth the rout-cause of a problem (Ward 2007).

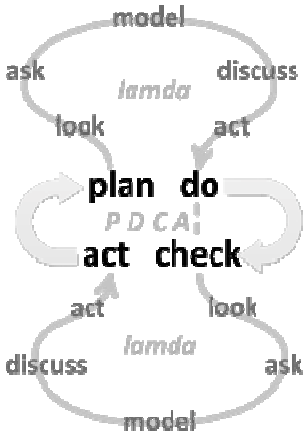

Figure 6, How PDCA and LAMDA connect

To be able to present what is going on in the PDCA- or LAMDA- cycle Toyota has developed an easy method of visually presenting this information. Toyota calls it A3, which is an A3 page consisting of all useful information to report problems, proposals, status of projects or just to share information (Liker 2009). Why Toyota chooses the format A3 is because it is the biggest paper fitting in to a fax machine. A typical A3-report is not a summary or a PM, it is the only report documenting a specific task. In Toyotas reporting system the PDCA- cycle forms the base for the A3- report and how it should be formed. There is no mandatory way of how an A3- report should look like. Important is that all relevant information is written on one A3 paper and that the information is visually presented in an easy way, preferably more pictures than words (Liker 2009, Holmdahl 2010).

4.2.4 Other areas to visualize

In the literature, other areas, except VP, such as continuous improvement and goals could be visualized. Examples of other areas that could be visualized according to Holmdahl (2010) are:

- **Prototypes or mock-up**: In order to give everyone a common understanding of what they are doing. By visually seeing the product you are working with, makes you understand what is expected from you and your team.

- **Issue boards:** This board is used in order to communicate questions and issues that are raised in a project or a group. This board could preferably be used in combination with a continuous improvement board, consisting of a PDCA- or a LAMDA- cycle.

- **Status board:** Also graphs and statistical data could be visualized. Depending of what kind of Key Performance Indicators, KPI, a company uses, different information could be visualized. Examples of measurable data that could be visualized are numbers of incoming improvement suggestions, delivery precisions or reclamations from customers.

Exactly what is right or wrong to visualize is not clear among the authors. Everyone has their own view of LPD and how it should be interpreted. But the summary, which the Manager for Toyota in North America stated in the beginning of this chapter, is a good summary of how a company could work with visualization according to LPD.

4.3 Implementation and Transformation

Change is inevitable when organizations want to carry out different types of improvements. Companies are constantly required to change if they want to survive in an ever-changing market in order to satisfy their customer's needs. According to Maylor (1996) one of the key factors explaining why companies have become prosperous, is because they have succeeded in becoming best at changing. One example of this is the company Harley Davidson who succeeded in changing their organization and their way of working in order to survive which thereby also improved their efficiency (Oosterwal 2010).

The main areas to take into consideration when a company wants to transform their organization and how to make it sustain in the long run is to understand the basic principles of change management.

4.3.1 Change management

One theory comes from Nadler & Tushman (1997) who describes three phases that every organization must go through in an organizational change in order to make it sustain in the long run. Those three states are current state, transition state and the future state, Figure 7. This is also discussed by Beckhard & Pritchard (1992), who refers to Kurt Lewins model of change, which entails going through three stages: Unfreeze, Change and Refreeze.

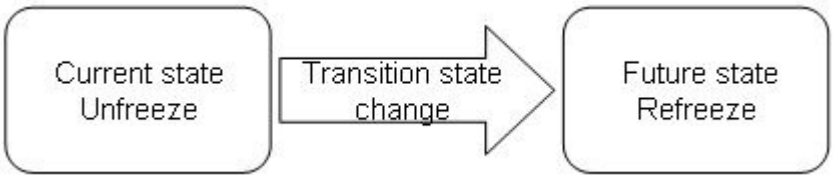

Figure 7, Version of the three states of organizational change by Nadler & Tushman (1997) and the learning process by Beckhard & Pritchard (1992)

When going from the current state to the future state the organization has to unfreeze from its present state and move to the future state. Unfreeze is when you let go of the old way of working and prepare for the future state. In order to prepare the organization for the change ahead the organization has to understand the purpose of the change and why it has to be done. A common way to do this is to create dissatisfaction with the current state e.g. through explaining how the situation today affects us in a negative way. Thereby people will get a greater understanding for the need to change (Nadler & Tushman 1997).

When the unfreezing of the organization is made it is possible to start working with changing the organization in the transition state. Here it is important to be clear with what is going to change and most importantly what will not change, which will create a sense of stability among employees knowing that not everything will be new and frightening. The stability and comfort that everything will not change will enable people to more easily change their behaviors and ways of working. At the same time they will be less afraid of changing and will instead be able to embrace the

future state and thereby be able to let go of the old (Beckhard & Pritchard 1992, Nadler & Tushman 1997).

When the organization finally has reached its future state it is important to, in a good way, be able to refreeze the organization into the new state so that the change that has been made can be sustainable in the long run (Beckhard & Pritchard 1992).

4.3.2 Sustaining the change

According to Nadler & Tushman (1997), any significant change in an organization will always affect the political dynamics, which will raise the issue of power: in leadership, group support, symbols and by building in stability in the change. The concept of shaping political dynamics relates to getting support from power groups in order to build up a critical mass in favor of the change (Nadler & Tushman 1997). To demonstrate a coaching leadership in support of the change will enable an easier learning process for the group members (Kennedy 2003).

Furthermore, Nadler & Tushman (1997) argues that using symbols, like names, graphics and signals, creates identification with the change and a common way to communicate through the change process. Another aspect is to build in stability in the change, which will reduce excess anxiety, defensive reactions and conflicts during the change.

Managing the transition state which is the actual time period between the current state and the future state is characterized by great uncertainty and control problems (Beckhard & Pritchard 1992). Communicating repeatedly in multiple channels a clear, stable vision of the future state will provide direction for the management of transition and reduce any unclearness regarding the change. It is also important to build in various channels for feedback in order to determine the progress of the transition. It can be done through formal methods as interviews, focus groups and surveys where employees can vent their motions and thoughts (Nadler & Tushman 1997).

One of the first questions that many people ask when going through a change is ”What’s in it for me?” (Söderberg 2011). This indication of anxiety occurs when people are faced with uncertainties associated with an organizational change (Coutu 2002). Management’s task is to relieve that anxiety and motivate constructive behaviors through a variety of actions such as for example rewarding desired behavior. Rewards can be formal

and/or informal such as pay, promotion, recognition, feedback and assignments can be given to obtain the desired outcome (Nadler & Tushman 1997).

Another area to take into concideration when changing organizations is the use of external help from consultancy firms. A consultancy firm could contribute to the organization with higher implementation speed and experiences from previous transformations in other companies (Aronsson & Friberg 2011). But they further argue that consultants can also be a big threat to the implementation if the companys employees does not accept or belive in the change. This is because many employees may feel that the consultants can be impersonal and does not know the companies business. What is also important to bare in mind when using consultants is to ensure that the new knowledge gained from the consultants stays in the company after the consultants have compleeted their mission, which can also be related to Kennedys knowledge arrow (Kennedy 2003).

4.3.3 Learning anxiety and Survival anxiety

For a change to happen individuals have to be able to change their habits and their ways of working which is always something hard to achieve without some resistance at first. According to Schein (Coutu 2002) *"Learning is not fun, learning causes guilt and anxiety when individuals have to relearn new things"*. Schein further states that there are two kinds of anxiety associated with learning: "learning anxiety" and "survival anxiety". Learning anxiety comes from being afraid of trying something new for fear that we will look stupid, that it is to difficult or that we will have to change our habits that we feel have always worked for us in the past**.** But people would never learn something new without experiencing the second type of anxiety, survival anxiety. Survival anxiety is the realization that in order to make it you have to change. The basic principle is that learning only happens when survival anxiety is greater than learning anxiety. Schein states in (Coutu 2002) that either the survival anxiety can be increased by for example threatening people with loss of jobs or valued rewards, or you can decrease the learning anxiety by creating a safer environment. He further argues that the best way to change peoples behaviors is to use the second approach by lowering the learning anxiety. This is also discussed by Ward (2007) where he mentions that to create a safe learning environment where failing is a part of the learning process is an example of lowering the learning anxiety among employees.

Studies have shown that if the employees accept the need to learn, then the change process can greatly be facilitated through good education, training, coaching, group support, feedback, positive incentives, and so on (Coutu 2002). To gain credibility leaders and managers have to become users themselves otherwise the group members will not accept the change (Kennedy 2003). Leaders have to practice wait-and-see attitudes together with patience in order to make the transition as smooth as possible for the employees (Coutu 2002).

4.3.4 Creating Anxiety

Coutu (2002) also mentions in her article that through history radical changes in companies have been a result of high survival anxiety. This leads to the conclusion that real change does not begin until the organization experiences some real threat that in some way forces them to question and change their previous beliefs or hopes. The threat is so painful to the company that it will create high levels of both learning- and survival anxiety which will ultimately result in a need to change.

Studies of change show that learning most often begins in small groups and then gradually spreads up in the organization (Coutu 2002). By using small pilot projects in the beginning which later spreads in the organization is a way to share best practices within a company. But if an organization wants to learn as a whole then top management must always impose new beliefs and practices to the entire membership (Coutu 2002).

Schein in (Coutu 2002) states that a trend today within companies is to create an environment that is built upon trust and openness by building flat organizations where employees are empowered and supported by the organization and other support functions that enables self managed teams. Every organization needs to always have the maturity and the patience to implement a change, they will have to accept that trying to change people's old beliefs and habits with totally new ones will be a painful and slow process. But if the company has a clear vision and goal to why they need to do this and are consistent in their choices that they are making then a satisfactory outcome will be more easily met (Coutu 2002).

5 Empirical study

As was stated in the introduction, the empirical section of this thesis is divided into two different parts. The first part describes the pilot study made at MHC and the results of this study, which lays the foundation for the main study. Therefore the pilot study is both reported and discussed in this section.

The second part is a benchmarking study of five Swedish companies that have implemented visualization in their organizations and two researchers within the area of LPD. The purpose of this benchmarking has been to learn best practices and gain knowledge regarding how to start an implementation of visualization according to LPD.

5.1 Study 1- Pilot Study

The results of the pilot study within MHC are based on interviews with 16 persons from the PD department, functions involved were eight Product designers, four Product Owners and four Managers. Focus during the interviews was to get a better understanding of MHCs daily PD work. For a more detailed description of how these interviews were conducted, see section 3.2.1 Pilot study in chapter 3 Methodology.

This first study aims to answer research question one: *In what areas of the PD process can MHC improve their work in order to be more efficient?*

5.1.1 Results

When the thesis was initiated the idea was to define and implement quality tools in the PD organization of MHC in order to support and facilitate their daily work. But what was found during the pilot interview study was that a quality toolbox was not what the PD organization needed right now. What we saw when the interviews were analyzed was that many of the employees in the PD organization were missing transparency and visibility in the organization during their daily work. For example, people did not understand the prioritization of different projects.

> *"We are working on multiple projects and it is hard to know which one that is high vs. low prioritized" (Product designer)*

Another area that was discussed among the interviewees was the area of informal communication ways. This problem arose due to MHCs rapid

growth during the past ten years. Ten years ago when MHC was a smaller company it was easy to find and retrieve information, but today with almost 7000 employees the situation has changed. This has led to a more complex communication and information flow within the PD organization.

> *"Even though I have worked at MHC for 15 years, I sometimes have problems finding information. I can only imagine how it must be for new employees"* *(Manager)*

Other areas that were discussed were the fact that employees felt that there was lack of communication between projects. This lead to repetitive work and that the same discussions were held over and over again because of lack of communication within the project organization.

> *"When starting up new projects, the same mistakes are often made. We should be able to learn more from previous experiences and projects"* *(Product Owner)*

It was also mentioned that it was common to change the project focus during the course of the project. This often happened due to lack of information and that new information was added late in projects.

One area that we have come in contact with is the area of meeting culture in MHSs PD organization. Often it is very hard to get in contact with people because they are in meetings. This was also something that we heard from the interviewees at MHC. Today people's outlook calendar is full of different kinds of meetings. In some of the meetings employees have a central role in the discussions and contribute greatly, but mostly they only contribute for a short amount of time and are participating in the meeting only to retrieve information. They felt that they could have done more value adding activities rather then spending time in long meetings and that the information could have been spread to them in other ways.

> *"Sometimes you are participating on hour long meetings, but you only contribute during ten minutes"* *(Product Owner)*

5.1.2 Conclusions of the pilot study results

When the collected data was summarized and analyzed, five areas were found to be of specific interest, these five areas are:

1. *Fragmented communication within the PD organization hinders the information and knowledge flow*. The effect of this is that many activities are done repetitively which is a waste of time and resources. Time which instead could have been used on value adding activities for the customers.

2. *No standardized way of analyzing and generating new solutions based on customer data*. The voice of the customer is taken into consideration by the product developers, but it is not done in a standardized way. This could lead to problems with securing quality in the PD process. Furthermore this can result in less innovative PD processes which could lead to products not meeting customers expectations. This is an area which MHC is already working on.

3. *Informal knowledge and information flow within the PD organization, due to unclear processes for sharing information*. Today people are using informal ways to get and share information because the formal communication channels are not developed enough within MHC.

4. *Problems with communicating project prioritization from top management to the PD organization, which leads to problems for the employees with prioritizing projects.* Prioritizations of projects are made by top management, and are usually not communicated down in the organization in an easy and understandable way.

5. *Heavy meeting culture, which leads to unnecessary long meetings and repetitive work.* Meetings are held for several hours but employees are just contributing for a short period of time or are just attending to get information. This information could have been spread in other ways and the time could be used on other value adding activities such as doing engineering. Also some subjects tend to be re- discussed over and over again.

5.1.3 Discussion

Some of these areas, mentioned above, were already targeted through ongoing internal improvement projects within MHC. Conclusions that could be drawn from the KJ- brainstorming were that the area of communication was affecting other problem areas as well. Therefore, by improving the communication at MHC the other four improvement areas will be positively affected, see Figure 8.

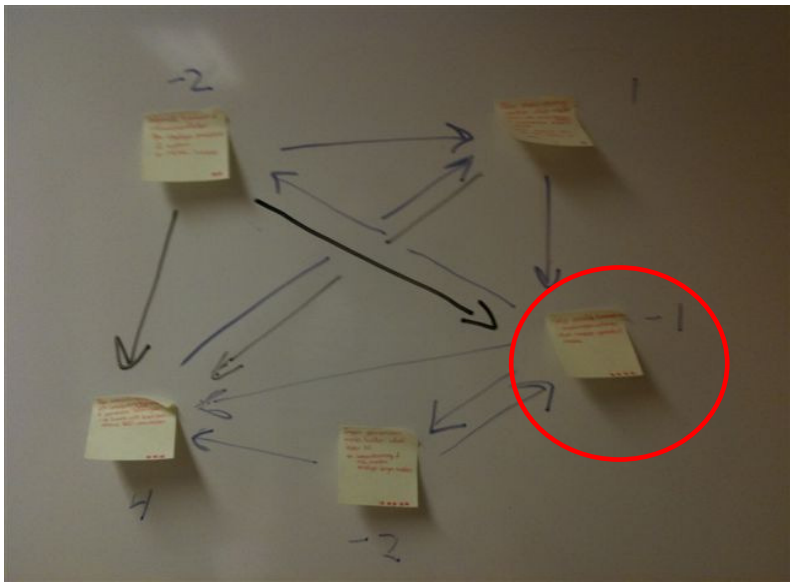

Figure 8, Result of KJ- Shiba brainstorming

When the results from the KJ- brainstorming were presented to our supervisor, Anders Karlsson, he mentioned that in 2009 he had done an Internet survey at MHCs headquarters in Gothenburg. In this survey 106 persons answered questions regarding the work done by Quality Affairs, QA. From the survey Anders concluded that more transparency in the organization was requested. Together with the results given in our study a discussion of how to continue the work with enhancing communication and increasing transparency at MHC was started. Discussions around Six Sigma and Lean PD, LPD, were held. After some discussions we concluded that the methods and tools included in LPD, especially visualization, were more suitable for MHC than Six Sigma. This was mainly due to the reason that Six Sigma focuses on reducing variation, while the LPD central thought is to use available recourse as effective as possible and reducing waste (Assarlind & Bäckman 2008). LPD focuses on more efficient processes and improved information flows which were identified as a need from the pilot study conducted at MHC. Therefore we

choose to continue with transparency and communication in this thesis based on the results from the KJ- brainstorming and Anders Karlssons survey in 2009. One of the interviewees participating in the pilot study even expressed:

> *"A few weeks ago I was listening to a very interesting LPD presentation, and I would like to try it"*
>
> *(Product designer)*

Allan Ward (2007) who has studied different companies and their LPD work promotes visualization, and states that visualization makes it easier for everyone in the team to be involved in the planning process, this is also stated by Alfredson & Söderberg (2011). It also creates an ownership of the planning by the whole team instead of just the team leader or project manager (Holmdahl 2010). It will also make it easier to level out the workload within the group when or if someone in the team is over loaded or needs help in some way. Furthermore, he also argue that visualization facilitates that every single person in the group can clearly see the main focus of the project, which makes it easier to front load the process and avoid late changes in the project (Ward 2007).

To conclude the findings of the pilot study, the most important areas to target are lack of communication and transparency in MHCs organization. In order to help MHC start working with visualization according to LPD and be able to create a usable visualization framework, a benchmarking study of five Swedish companies and two researchers was conducted. The findings and learning from benchmarked companies and researchers, which was collected through semi structured interviews, will now be presented and discussed in the second part.

5.2 Main study - Benchmarking

The main study consists of a benchmarking study made among Swedish companies and researchers. Findings from these interviews and study visits will later be analyzed and concluded into key recommendations for MHCs PD organization.

In order to find out how other Swedish companies have started working with visualization according to LPD, five Swedish companies and two Swedish researchers were interviewed. These companies and persons were

chosen in order to get a broad understanding of how MHC should start their work with implementing visualization.

5.2.1 Description of involved companies and Researchers

Ascom– Wireless Solutions

Ascom Wireless Solutions specialize in wireless solutions for on-site communication regarding speech, messaging and alarm systems. Their business concept is to customize complete solutions on the basis of unique customer needs. The company was founded in the 1950's and has today 1200 employees worldwide with their head office in Gothenburg. Ascom Wireless Solutions is one of two core businesses within the Ascom group. Ascoms market segment includes health care, security facilities and the process- and manufacturing industry. VP was introduced at Ascom in 2006 through an initiative taken by Mats Espling, R&D Manager at Ascom. Today, 5 years later, VP has been implemented in the whole company (Ascom 2010).

Atlet

Atlet is one of Europe's leading truck manufacturers and material handling experts, who provide their customers with warehouse and counterbalance trucks. Knut Jacobsson started Atlet as a family business founded in Gothenburg in 1958. Today Atlet has around 1000 employees worldwide. In 2007 Atlet was purchased by Nissan and became a member of Nissan Forklift Co. Ltd. Marita Christmansson, Lean Coordinator, who was interviewed works with supporting their Lean initiative Atlet Operations System, AOS. AOS was started in 2007 in order to retain their leading position as a global truck manufacturer. Today all white-collar workers are working with visualization according to AOS (Atlet 2011).

Autoliv

Autoliv is a world leader in automotive safety with around 43 000 employees in more than 30 countries. They supply safety products to all big car manufacturers worldwide with products such as seat belts, airbags, anti-whiplash systems, active safety

systems and other safety systems. Autoliv has used the Lean production methods since 1995, which 2002 resulted in the Autoliv Production System, APS, influenced by Toyota Production System. The Lean PD managerial initiative at Autoliv started in 2004. It focuses mainly on Visual Planning, VP, kaizen groups and education of the staff in the area of "customer first". Autoliv was awarded the Swedish Lean price in 2010. At Autoliv Anders Svantesson from Quality Development was interviewed. Anders has worked at Autoliv for many years and has taken an active part in their Lean initiative (Autoliv 2011).

Scania

Scania was founded in the early 20th century and have since then grown to become one of Sweden's most important manufacturers of heavy trucks, busses, industry- and marine- engines. Scania operates in approximately 100 countries and has 34 000 employees. Their main office is situated in Södertälje and this is also were their R&D department is situated. At the R&D department over 2400 persons are working in different projects. Scania is focusing on developing products that are customized for each customer. This is possible through Scanias modular product system, with a limited number of main components. Scania started their work with visualization about 10 years ago and has today a mature way of working with LPD. One of the driving forces in this work has been Peter Palmér, Senior Manager, Head of Process Development at Technology Development. During the benchmarking also Göran Bodlund, Improvement Coach, Process Support at Technology Development, participated (Scania 2011).

Volvo Powertrain

Volvo Group is divided into seven different business units, where Volvo Powertrain is responsible for developing and producing heavy engines, gearboxes and driveshafts. The Volvo Group focuses on delivering transport solutions for commercial users. Today 90 000 employees are working world wide in the Volvo Group. In 2005 the work with Volvo Production System, VPS, was started in order to coordinate the work of improving Volvos production. The next step taken by Volvo was to also increase the efficiency in PD. This was the start of Volvo Production System- Product Development Process, VPS- PDP. In VPS- PDP focus is on reducing

waste in order to improve the efficiency. But also visualization and communication according to LPD is of great importance. For the benchmarking Sam Gohari, Global Process Development Manager at Quality & Process, was interviewed (Volvo 2011).

Stefan Bükk, Swerea IVF

Stafan Bükk is a Swedish researcher, teacher and consultant in the area of LPD. Stefan is today working at Swerea IVF, a Swedish research institute focusing on innovation, PD and production. Swerea is 50% owned by the Swedish industry and 50% by the Swedish government. Earlier Stefan has worked at the production line at Volvo and at Saab Automobile. Stefan is also leader for the Swedish LPD network and has a tremendous network world wide of known persons within the area of LPD (IVF 2011).

Björn Söderberg, Chalmers School of Technology

Björn Söderberg is a PhD student in PD Management at the Department of Technology Management and Economics at Chalmers University of Technology. Söderberg researches within the area of Lean principles and methods. He has an M.Sc in PD from Chalmers University of Technology and presented his thesis in 2009 regarding LPD, with focus on Lean principles and methods that facilitates knowledge transferring. He has also published some conference papers within the area of LPD (see Alfreson & Söderberg 2011, Chalmers 2011).

5.2.2 Results

All data collected from interviewed companies and researchers has from the questionnaires been coded according to four main areas, which will be further discussed in below section. These four areas are:

- Why do companies implement visualization according to LPD and how did it start?
- What is important to visualize and why?
- What results have companies seen from implementing visualization?

- What is important to take into consideration when implementing visualization?

Why do companies implement visualization according to LPD and how did it start?

The reasons for implementing visualization according to LPD differ between involved companies. Common in all benchmarked companies is that the implementation of visualization was conducted according to the LPD philosophy in general, where visualization is one method to increase the communication and transparency. What we have seen from our benchmarking is that one of the strongest factors why companies are implementing visualization is because they have realized that in order to be competitive on the market today you have to focus on the costumer and improve the communication. Marita Christmansson, Lean Coordinator, Atlet, said:

> *"The reason why we implemented AOS was that we needed to be competitive and show results to our new owner in order to make Altet sustain in Mölnlycke"*

From the implementation of visualization benchmarked companies would see effects of improved communication and increased efficiency within their PD organization. Only one company, Volvo Powertrain, had expressed a goal to decrease their costs and increase their efficiency. Other explanations to why implementing visualization according to LPD is useful are that it sounded interesting and they wanted to be visionary.

How the implementation of visualization methods was initiated also differed between the companies. Atlet and Volvo Powertrain had a top down approach from top management, whereas Ascom made a survey to see how "Lean they were" and then started their implementation with initiatives taken by enthusiastic employees in different groups. This approach of implementing visualization is a form of bottom up initiative, which later spread within the organization when people heard about it and got interested. Scania and Autoliv had experience of visualization from production and understood the positive benefits and effects of it, and this knowledge was later on spread to the R&D organization. Common among all benchmarked companies is that everyone in some way used pilot-projects to test the effects of visualization.

As discussed above three different types of implementation of implementing visualization have been detected from this benchmarking. These three are top down, bottom up or a continuation from production into PD. Which one these three approaches is the "best" is impossible to say, it depends on the company. All benchmarked companies are satisfied with their implementation and the outcome. Why they choose their specific approach depends on the company culture and political dynamics within the company. Common for all these three approaches is that everyone have in one way or another used external consultants and lectures in order to gain knowledge and experience. This is also something as Björn Söderberg, PhD Student, Chalmers University of Technology, discussed during our interview, where he stated:

> *"To get people involved and interested, you have to educate and train employees in order to understand the positive effects. Use someone experienced to create trust and insight"*

Scania used some consultants in the beginning to gain knowledge but are today instead using in-house knowledge, with the argument according to the Kennedy knowledge arrow, Figure 1 page 11, that knowledge should be built up and stay within the organization. Atlet has used another more consultancy driven approach, where a consultancy firm lead the implementation. Today they have taken over the responsibility themselves but are still using the consultancy firm as a support.

What is important to visualize and why?

When asking what is important to visualize, some of the companies answered "*everything*". One example was given by Peter Palmér, Senior Manager Scania, who said:

> *"The best way to visualize all customer claims is a pile of damaged products in front of the main entrance so that everyone visually sees it and understands that we have problems"*

What Palmér means is that visualizing problems like for example claims is an easy and simple way to make everyone see and understand the problems and thereby be able to act accordingly to solve them. Looking at what different companies have chosen to visualize in order get inspiration to MHC, there are some areas that are reoccurring. What all companies have done is to visualize a Visual Planning, VP, board consisting of a short-, mid- and long term planning. Short term usually

covers one to two weeks, mid term covers up to approximately six months and long term could be the whole project, in some cases up to five years. This planning is not a copy paste of their outlook calendar; instead it is a planning focusing on deliverables and critical paths. Examples of things to visualize are: deliverables from a group to a certain project, deliverables between groups, important gates or release dates, information regarding out of office and vacations and problems that may be critical if no one deals with them. To understand and easier see what kind of information people want to communicate, Post- its with different color- codes were used. Examples of colors that we saw were:

Yellow: Planned activity

Orange: important delivery

Green: Activity/ delivery from someone else

Pink: Critical problem

Blue: Out of office/ vacation

Some companies like Atlet has standardized all colors within the company, whereas Scania in the beginning let every group decide which colors they would like to have, but today the majority uses the same colors. One discussion that have come up during the interviews is what to do with old post- its. Should you keep them or throw them away? In this subject there are disagreements. Ascom and Autoliv are not saving their post- its because they do not feel a need for documenting what has been done. What Ascom did was to use a decision log, where all their important decisions are stored. While Atlet and Scania are saving their post- its in a book, in order to be able to go back and follow up on what have been done and which decisions were made during the week.

All benchmarked companies also have experienced that VP encourage shorter and less complicated meetings. Instead of long meetings in a conference room, shorter meetings approximately 5-15 minutes, are held more than once per week. During these meetings everyone is standing up in-front of the board and can thereby visually see and understand the current situation.

To increase the communication between projects and all line organizations, e.g. finance, quality and marketing, Ascom and Scania have

chosen to introduce a cross-functional board called a “Pulse board”. A Pulse board is a board, which connects all projects with each line organization. On one axis all projects are visualized and on the other axis line groups are presented, and together this creates a matrix. In each square that connects a project and a line a color marker is placed, this marker could e.g. have the color green, red, yellow and white. This marker communicates if everything is ok in the project (green), if there is a problem (red), if it could become a problem (yellow) or if the project and the line do not have any correlation, white.

In order to achieve short and effective stand up meetings in front of the Pulse board, only red and yellow markers are discussed. Another board that was used in order to synchronize different activities within a project was a synchronization board. In this board different functions in a project were visualized versus a time line in order to make it possible for the different functions to synchronize activities to each other. This synchronization board also makes it possible to front load a process and to do several activities in parallel.

Furthermore, continuous improvements were also visualized at Atlet and Autoliv. This was done according to the PDCA- cycle where everyone involved are able to come with improvement suggestions. To be able to see each suggestions path from identifying a problem to solving it, a board where each suggestion is moved visually from P to D to C to A is visualized.

The reason why each area is visualized is to in a more easily way see and understand that someone is working with a specific improvement suggestion. What we also have seen in the study is that every company that is working with continuous improvements in this way is using a template, where information and description of each improvement is written down. Often when an improvement has been made it is visualized and communicated within the organization.

Other areas that we have seen visualized during our benchmarking are project goals and company vision, Key Performance Indicators, products and prototypes, statistics of incoming improvement suggestions and delivery precision. Many of the benchmarked companies also have shorter descriptions of how to work with their visualization boards e.g. descriptions of how a stand up meeting should be held. Volvo Powertrain

also had a structured communication policy, where all employees could come in with a communication suggestion to a communication committee, which later were discussed and communicated by e.g. mail, phone, workshop etc.

What results have companies seen from implementing visualization?

It is very hard to measure results of an implementation of visualization in PD. In production you can easily measure if there are any defects or spill of material. But in PD it is harder to see exactly which activities that are contributing or not. When we asked what kind of results companies have seen from an implementation answers like Anders Svantesson, Quality Development, Autoliv, were given:

> *"We do not measure because we are not interested in numbers. What is most important for us is that our employees feels comfortable and understands the positive effects of visualization"*

Autoliv and Scania instead sent out employee satisfaction surveys in order to get a better understanding of how the overall perception is of their way of working, or if there are improvements that have to be made. Examples of measurements that were made by other companies in the study e.g. Atlet, was measurements of delivery precision and numbers of incoming and implemented improvement suggestions. Some of the involved companies in our study also measure time used for a certain activity. What we heard from Stefan Bükk and also saw at Scania is that before an activity is posted on the VP- board an estimated time has to be added. When the activity was completed the actual time was noted. By doing this everyone always tries to continuously improve themselves in their daily work.

Effects that have been seen from implementation of VP were that team members became more involved in the project and took more responsibility. At Atlet we met a Product developer who said:

> *"In the beginning it was a bit complicated working with visualization boards, but when you understand how to work with it, it actually helps you. And your manager can at the same time understand why you are stressed and won't be able to deliver a certain task"*

By increasing the involvement of the team members the effect was that everyone could easier be a part of the planning, which earlier was mostly,

or sometimes, only done by the managers themselves. When you post a note on the board you make a commitment with your team to solve this task. This is a very powerful effect that all involved companies felt. Other effects are better communication both within the team and within the whole organization, due to that everyone can pass by and get a quick overview of the situation. This is also obtained by having short and regular meetings, preferably more than once per week. As stated by Mats Espling, Manager R&D, Ascom:

> *"People do not always read emails, but it is possible for everyone to participate in a five minute meeting"*

Overall, involved companies have also felt that it is easier to make decisions and to detect and solve problems faster. Another positive effect that all companies involved mentioned was the possibility to easier level out the workload among members in a team. If everyone can see what their team members are doing and see if they have a problem, it is easier to help each other.

What is important to take into consideration when implementing visualization?

What many of the benchmarked companies mentioned was that when implementing visualization it is important not to use the expression "Lean", if it is not an accepted term in the company. Lean is associated with Toyota and often people see it as a philosophy that is only suitable for the automotive industry (Kennedy 2003). This is something that we could see in all companies. Volvo calls it Volvo Production System - Product Development System, VPS-PDP, Autoliv uses the name Autoliv Production System, APS, and Atlet calls their initiative Atlet Operation System, AOS. Ascom and Scania however talk more about visualization and VP. Scania argues that you should not try to focus so much on the Lean principles, it is better to use common sense when implementing VP. The majority of the interviewed companies said that a lot of patience is needed when implementing VP, it will take longer than expected and it is hard to set an end date. This was also discussed during the interviews with Stefan Bück, Swerea IVF, and Björn Söderberg, PhD Student, Chalmers University of Technology. Stefan argued:

> *"Do not see it as an implementation, see it instead as a transformation. Since LPD is an iterative process that never ends, you can always improve your work"*

The argument which Stefan Bükk states above is also coherence with the LPD literature. Morgan & Liker (2006) argues that in order to become leading on the front edge of the market a company can never be satisfied, you always have to improve. In Japanese it is called *Kaizen,* which infer continuous improvement.

Only one company, Atlet, had a strict time frame for the implementation of visualization and stated that an implementation in a new group would at least take six months. Within these six months a Lean coordinator coordinated the implementation work which was conducted in the same way in all teams. After this period each group could adjust their visualization work to their specific needs, for example: amount of meeting per week and timeframe of the long-term planning.

A common opinion from all interviewees has been to not try to copy paste from other companies when implementing visualization in your own company. They further argue to always try to create something that suits each companies and groups needs and build up visualization boards which facilitates their work. Ascom said that it is harder to keep visualization alive in the long run than the actual implementation, due to that everyone has to be involved and contribute in the visualization work to succeed. Making sure that visualization is implemented with both short term as well as long-term goals is also important in order to see the benefits and the progresses done by using the visualization approach.

Peter Palmér, Senior Manager at Scania mentioned that it is important not to push too much on methods and tools when implementing a new way of working. He further argues that visualization should not be forced upon any one or any group, it should always come from the group and be based on their needs of visualizing. Moreover the visualization initiative should not be too structured or method driven, because you need to adjust the change to the company's culture and needs. Palmér said:

> *"It is important to keep a good balance between culture, structure and methods"*

Atlets approach was to focus strongly on LPD methods and tools, by having a good structure and control over the visualization initiative. This approach demands more out of the management, but at the same time it will give the employees a clearer vision of what the results will be after the implementation.

The balance between how each company involves external help, such as workshops and external consultants and lecturers, differs between the benchmarked companies. Scania and Ascom argue that external consultants are good to use in the beginning as an inspiration, and later the company should try to do as much as possible by themselves. The argument why this is a god way to go is that each company is unique and what works on one company does not necessarily work for another. And that many consultancy firms use the same model on every company, which could lead to rework later because of that their model did not fit the company's organization. Therefore Scania uses what they call "train the trainer" which means that an internal improvement team trains a leader who later trains his or her team. In this way the knowledge is created and stays within the company. But at the same time Atlet argues that their firm used a very consultancy driven approach during their implementation, and it has worked very well for them with good support and guidance through the process.

Companies differ also regarding if the group members should create their own board in their own way or if it should be a common structure for the whole company. Ascom and Scania argue that the team that uses a VP board should themselves create the layout and the content of their boards. Autoliv have some areas that were mandatory and some areas that could be chosen by the team, whilst Atlet had a clear top-down approach where all visualization was structured in the same way so that it could be comprehensible for everyone in the company.

Another positive effect which all companies have seen with VP boards is that visualization of deliveries makes it easier to level out the workload between the team members, and at the same time it creates a sense of ownership of the work tasks. Visualization also facilitates identifications of deviations and faster problem solving, something that all interviewees have seen. Scania and Volvo Powertrain expressed that in order to achieve this, it is important to work with the individuals, to make them understand that visualization are supporting them in their work rather then seeing it as

an extra procedure. Björn Söderberg, PhD Student, Chalmers University of technology, stated during our interview that to make everyone understand "what's in it for me", is crucial to make everyone committed to the new way of working.

All involved companies think it is important to regularly follow up on the visualization work in order to evolve and to be able to continuously improve as a company. Stefan Bükk, Swerea IVF, argues that it is important to learn from your mistakes in order to be able to improve, and that in the philosophy of LPD mistakes are accepted but you have to learn something from each mistake. Another area that was discussed by Peter Palmér, Senior Manager, Scania, was that employees might in the beginning of working with visualization feel some discomfort when visualizing what they do. Sometimes employees are too proud and have problems admitting that they have weaknesses. This is a common problem area when implementing visualization that the company has to be aware of. But by creating a culture within the organization where failing is accepted will make it easier for employees to admit their weaknesses and accepting that they sometimes need help.

What we also heard from Atlet was that there have been some problems when moving from the line organization and starting an implementation of visualization into the project organization. People thought that it felt complicated and unnecessary to have so many different boards to update at the same time. But they could not give any clear suggestion on how to solve this.

5.2.3 Key Findings from benchmarking study

In Appendix 4- Key findings from benchmarking study, key findings regarding visualization and implementation of visualization from each company and researchers involved in the benchmarking study are summarized. These findings will later be used in order to build up a visualization framework for MHC.

One key finding which we want to highlight is that it is important to not "copy paste" from other companies. What we mean is that you should not take a concept from someone else without first adjusting it to your organization. Even if every company is unique and is working in different business segments you could collect information from other companies before starting a visualization implementation. It is possible to use the

same philosophies, but not straight of. Another common misunderstanding regarding LPD among companies is that they think the LPD philosophy only works for car manufacturers and is not possible to implement in other business segments. But our benchmarking study shows that visualization according to LPD works for all companies even outside the car industry, it is all about the mindset and how the organization is working.

5.2.4 Discussion

As we could see from the benchmarking study there is no "best" way to start an implementation of visualization. What we could see is that all benchmarked companies have got their inspiration to start their work from Lean production and LPD. Lean was introduced to the western world in the beginning of 1990s (Womack, Jones & Roos 1990). LPD is even newer, only the past ten years companies have worked towards this philosophy. As we have seen both from the literature and from the results gained from our benchmarking study, visualization can be a powerful and rather easy tool for companies to start with. This is according to Holmdahl (2010) also what Swedish companies first start with when implementing LPD. Even though visualization is quite an easy tool to implement companies will still have to expect that employees will experience anxiety towards this new way of working (Coutu, 2002). According to Peter Palmér, Senior Manager, Scania and Stefan Bükk, Swerea IVF, Swedish companies are world leading in terms of working towards the LPD philosophy.

In the analysis below we will connect the results from our benchmarking and reviewed literature to our research questions 2 and 3 -*How do companies in Sweden work with visualization in PD organizations?* And -*What are the most important aspects regarding implementation of visualization in PD organizations?*

How do the benchmarked companies work with visualization in PD organizations?

Visualization has been implemented in benchmarked companies in order to increase the communication and knowledge transfer within their organization. The reason to why visualization has been implemented differs between the studied companies. Scania found it hard to know the status of different activities, Autoliv wanted to try something new, Atlet needed to improve their deliveries, goals and time-frame precisions in their

projects and also be able to handle both short- and long- term problems in a better way, Volvo Powertrain wanted to improve their R&D work and decrease their costs, whereas Ascom made an investigation of how "Lean" they were in order to improve their work.

The Benchmarked companies all wanted to have an environment that continuously communicates to their employees in an easy and understandable way. This is in line with how Kennedy (2003) describes Toyota, where he argues that the communication at Toyota is not forced, it is simply a natural result of the environment.

According to Morgan & Liker (2006) and Alfredson & Söderberg (2011) visualization makes it easier for the project manager or team leader to plan and divide activities among his or her group. By using VP everyone is involved in the planning instead of just the project manager or the team leader. As Peter Palmer, Senior Manager, Scania stated:

> *"If you can't see, you can't understand and therefore not act. But if you can see you can understand and thereby act upon what you know*"

Palmér further argues, for example if someone in a project has a problem and does not communicate it, then no one will be able to help. But if it is visual on a board on the wall everyone can see that someone has a problem, and be able to help. As Morgan & Liker (2006) argue this can be one of the aspects why people are restricted against VP. It is important to admit one's weaknesses and that you need help, and this can for many people be very hard, but by creating an environment which facilitates continuous improvement this problem can be avoided.

Another aspect that all benchmarked companies have seen is the improved communication flow within the organization. Knowledge from individuals can easily be spread within the organization. Looking at Kennedy's knowledge arrow, knowledge from different projects and persons are transferred into the organization (Kennedy 2003). This is a great benefit for all organizations, since information stays within the company if someone leaves. One way to transfer information from the individual into the organization is to use A3 reports (Liker 2009). A3 reports were for example was used by Ascom, Autoliv and Scania to spread and communicating information. What we found was that the involved companies did not think that the format of A3 was important, which Liker

(2009) states that Toyota uses in order to fit the report in a fax machine. Instead they stress that what is important is to find a format that suits the specific organization and is built up in way which communicates clearly to everyone in the organization.

All benchmarked companies are in one way or another working with continuous improvement. This is done in different ways by for example using issue boards. Some companies also visualize their improvement results by visualizing their continuous improvements on a board which is built up according to the PDCA-cycle (Deming 1986). To standardize this process and to make it understandable for everyone, templates are used by the benchmarked companies. It does not necessary need to be an A3, but the idea and layout are taken from LPD and Toyotas ideas (Liker 2009).

Even if the benchmarked companies have not really measured the results of implementing visualization effects of an implementation has been seen. As discussed above it has increased the communication and transparency within benchmarked organizations, which has lead to more involvement by the employees. Alfredson & Söderberg (2011) mention that VP could encourage the possibility of workload leveling, which benchmarked companies also have seen as an effect of VP. As was mentioned in the literature, companies today tend to focus too much on the short-term cost saving goals (Morgan & Liker 2006). But in the five Swedish companies that was benchmarked, there were less focus on measuring and instead focus was put on individuals and thereby improving the company as a whole. The benchmarked companies are also well aware of the time and patience needed when implementing a new way of working. This is also discussed by Schein in Coutu (2002), where he mentions that implementations always take longer than expected.

Exactly what a company should visualize is not clear. The literature talks about different areas to visualize e.g. VP, continuous improvements, issue boards, prototypes, mock-ups and status boards (Holmdahl 2010). But from the benchmarking study we have seen that it differs a lot between all benchmarked companies. What has been seen from the benchmarked companies is that short-, mid-, and long-term planning is used by everyone. Also boards visualizing continuous improvements are used. Furthermore also prototypes, statistical data, company or project goals and descriptions of how to work with VP were also visualized.

According to Björn Söderberg, PhD Student, Chalmers university of Technology, one company that was not included in our benchmarking study is working with something they call synchronization plans, which is made in order to see the critical path of projects. They do this in the start up of every project in order to be able to front load the project and see if it is possible to do parallel activities, and by that shorten the time of a project, and also the time to market. This way of working also encourages the communication both upstream and downstream, which is discussed both by Wheelwright & Clark (1992) and Müller (2006). Müller (2006) also states that when communicating in an organization it is important to differentiate between who owns, communicates and receives information. This is something that Volvo Powertrain has taken into consideration when creating their communication policy that visualizes all information that should be communicated within their PD organization.

As Holmdahl (2010) argued earlier, the reason to why Swedish companies, have been able to implement the philosophy of visualization according to LPD is due to the Swedish culture. In the Swedish culture everyone can talk to each other, independently of which position you have in the organization, and it is not as embarrassing for a Swedish employee to lose his or her face, as it would be in e.g. Japan. But the organization must facilitate learning and that it is ok to do mistakes. This is something we think the benchmarked companies have succeeded with.

What are the most important aspects regarding implementation of visualization in PD organizations?

There are many aspects to take into consideration when implementing visualization in a company. As for any kind of implementation, change will be inevitable as stated by Nadler & Tushman (1997).

According to Volvo Powertrain and Scania it is important to make sure that the initiative is done for the right reasons when implementing visualization due to that visualization is not necessarily suitable for all companies. As all companies have said, it is vital that the visualization initiative in the company is not copied from other companies. All companies are different and therefore have different needs, which cannot be solved in the same way. That is why the visualization initiative and implementation in a company must be done in their own way.

Implementing visualization according to LPD is not done overnight, all companies that have been interviewed agree that it takes time, often longer than they thought, in the beginning. To keep up the spirit among the employees, the company must be patient and communicate continuously what the goal with the change is and how they plan to get there (Nadler & Tushman 1997). Mats Espling, Manager R&D, Ascom, argued that it is important to be aware of that implementing visualization is often easy, but that it is harder to keep it alive in the long run. Beckhard & Prichard (1992) argues that any kind of implementation of a new way of working will force the organization to change and that it is always hard but necessary in order for the company to reach their goals. They further say that the one responsible for the implementation should be aware of the three different stages, current state, transition state and future state which every organization has to go through when changing. Nadler & Tushman (1997) also mentions the importance of informing all employees involved in a change what "will" change and most importantly, what "will not" change. This is often helpful when trying to affect the way people react to change. Using symbols and common colors on the post-its or different types of markers that everybody understands can be useful in order to lower the learning anxiety in the change process (Nadler & Tushman 1997).

Benchmarked companies involved in our study have had three different approaches of how to start working with and implementing visualization. From our study it cannot be said which approach is the "best" since every company is unique. But what can be said is that all companies have in one way or another realized that they do not possess all knowledge regarding visualization in-house from the start, and have therefore used external help. This approach is also mentioned in Aronsson & Friberg (2011) who argue that consultants can contribute with relevant knowledge and speed when implementing a change. Usually combinations of consultants, guest lecturers and having workshops have been used at the benchmarked companies. According to Björn Söderberg, PhD Student, Chalmers University of Technology, workshops can be used sometimes to give employees an opportunity to express their feelings and thoughts. This is also a good opportunity to try to create the wanted mindset when working with visualization (Nadler & Tushman 1997). As Kennedy (2003) states, companies should try to transform external knowledge into the organization. Especially Sam Gohari, Global Process Development

Manager, Volvo Powertrain, expressed this, regarding that the knowledge from external consultants must be transformed in to the organization in order to build up in-house knowledge.

After having planned and decided upon the above aspects the actual implementing phase can begin. The size of the implementation differs a lot between benchmarked companies, everything from small pilot projects to implementing on the whole company at once. But the majority of the interviewed persons have said that from their experience they would recommend to start the implementation on smaller projects, for example on pilot projects. Focus on making it work on the smaller projects and later on let it spread in the company (Coutu 2002). Ascom has seen that the first VP-projects have created a natural curiosity within the organization, which has created an interest for VP in other groups. As Nadler & Tushman (1997) discuss, it is important to get critical power groups in the company in favor of the change ahead which will facilitate the implementation, which some of the studied companies have experienced.

Holmdahl (2010) argues that visualization is quite easy to implement in Swedish companies, due to our culture, but there can still be some barriers that have to be passed. Such as the anxiety barriers mentioned in Coutu (2002), where Schein argued that learning only happens when learning anxiety is greater than survival anxiety. Increasing the learning anxiety by seeing mistakes as a part of the process has been seen among the benchmarked companies.

Another interesting area that we have seen at the benchmarked companies is the idea of simplifying and visualizing as much as possible. The discussion regarding if visualization- boards should be standardized or not differs between the companies, and there is no “right” answer. Peter Palmér, Senior Manager, Scania says that the boards should be designed to fit the company’s needs. Let the boards evolve over time and adjust them when it is needed and thereby let visualization in the organization grow in a natural way. It is important to ensure that everyone involved in the visualization work sees and understands that visualization and VP is a tool that is there to support them. And that it is not just another activity that they have to fit it in their busy work schedule (Nadler & Tushman 1997).

Furthermore, another important learning that the benchmarked companies have mentioned when implementing visualization is the role of the leader.

Supporting leadership means that the group leaders have to trust their team members in what they do (Nadler & Tushman 1997). He or she also has to practice a delegating leadership, which can be done by delegating more to the team members and giving them more responsibility. It has also been mentioned by the companies that it is vital that everyone "live as they teach" in all that they do, as is also mentioned by Schein (in Coutu, 2002). This will make it easier for the organization to accept the change because everyone, even the managers are working in the same way.

As Müller (2006) and involved companies state, it is important to use both informal and formal information channels such as having a good balance between informing in formal meetings and official documents and informal conversations by the coffee machine. Using these two channels can create support from the organization and making the employees understand why visualization has been implemented, which enables an easier implementation (Nadler & Tushman 1997). They further discuss, as for all changes it is always important to follow-up the improvements in some way or another in order to be able to adjust and steer the work in the wanted direction. This has been done at the studied companies for example by sending out questionnaires to get a better picture of their reality and gathering peoples opinions about visualization.

5.2.5 Key recommendations for MHC based on the benchmarking study

Every company is unique and what is working well for one company could fail for another. One discussion is regarding the use of external consultants. Another is how much top management should regulate every single team's visualization board. Some companies have very strict policies of how every board should look like, whereas other companies let every group decide the layout of their board. We think that a mix is the best way to go: use consultants to get inspired and to get useful input, but later try to do as much as possible yourselves. This is also confirmed by Aronsson & Friberg (2011) where they state that there should be a balance between the use of in-house knowledge and consultancy firms when implementing new ways of working. We also recommend building up an internal team that educates and supports the rest of the company in their work. Scania called it train the trainer, which means that their internal team trains a group leader and later he or she trains his or her team. With

this approach you also build up and keep the knowledge within the company (Kennedy 2003).

During our benchmarking we also discussed how to solve the global aspect, due to that MHC is a global company with R&D functions all over the world. But we did not get any good answer of this question. Anders Svantesson, Quality Development, Autoliv, argued:

> *"You can not play a football match on two different fields at the same time"*

He means that if you want to work with visualization according to LPD it is important to have the team located at the same office. And that the power with visualization is the commitment you are doing when you write a post it and put it on your board. But we also heard examples from Stefan Bükk, Swerea IVF, of companies that have tried to use computer system with a projector to get the same effect as a physical board on the wall. And we saw one example at Ascom where they were using a conference phone in order to get people in other countries participating in their pulse meeting. Moreover, Anders Karlsson, Global Quality Manager R&D, MHC, saw during a study visit at SKF, that they were using web- cameras to solve the global issue of visualization. So we think it is possible to make visualization global, but we have seen to few good examples in order to make a valuable statement for MHC.

Another interesting discussion about the global aspect related to the concept of visualization and VP boards according to LPD is regarding what to focus on. Should the focus be on the actual VP board and post-its or should it be on increasing the overall communication in a company. By putting a post- it on the VP board and committing to deliver in front of your team creates empowerment. This can off course be hard to achieve in a global organization, but regarding the philosophy of shorter and more effective meetings and to encourage and to increase the communication the LPD philosophy is effective even in global organizations. This must be the main positive effect which a company wants to achieve, to increase the knowledge transfer by increasing the communication. The fact that post-its and whiteboards are very well suited to increase the communication is a fact but it is important to bear in mind that only by implementing whiteboards the communication is not automatically increased. It is about

the mindset and how the company is acting. Therefore we think that the philosophy of LPD and visualization is suitable for global organizations.

6 Conclusion

Today companies are in an ever changing market which demands high flexibility and variety of products whilst securing the same high quality at a reasonable price. This Master Thesis was initiated by Anders Karlsson, Global Quality Manager R&D, MHC for the PD department at MHC. Research question one ("*In what areas of the PD process can MHC improve their work in order to be more efficient?")* was answered through a pilot study at MHC which consisted of 16 interviews, where 5 improvement areas were identified to be the reason to how MHC could be more efficient in their PD processes. The main reason was that MHC had unclear parallel communications which lead to repetitive work.

These findings made us look into some Lean and LPD literature to see if they had any tools or methods that could help eliminating unnecessary work and at the same time enable better communication within a company. What seemed to suit MHCs needs was visualization according to LPD. Visualization would increase the communication within MHC through transparency. Three research questions were stated based on the findings from the pilot study: "*How do companies in Sweden work with visualization in PD organizations?", "What aspects are important regarding implementation of visualization in PD organizations?"* and *"How can MHC start an implementation of visual planning of their PD organization?"*

A benchmarking study including five Swedish companies and two Swedish researchers within the area of LPD was conducted in order to learn from their experiences. Through these findings we were able to answer above mentioned research questions.

To answer the Research question "*How do companies in Sweden work with visualization in PD organizations?"* we found that all Swedish companies chose to implement visualization according to LPD because they needed to increase their communication and knowledge transfer within the company. This was done by for example visualizing their planning, improvement suggestions, products, company goal and strategy, issue boards, mock-ups and status boards. But what they all were very keen to inform us was that they had chosen to visualize only what they were in need of visualizing and that they have not tried to "copy paste"

from others. What they meant was that each company that chooses to implement visualization should do it for their own reasons and adjust it to their needs, otherwise the implementation might fail.

As was mentioned in above research question it is always important that the visualization initiative is made for the right reasons and that there really is a need for this tool. To answer the question *"What aspects are important regarding implementation of visualization in PD organizations?"* it is important to be very patient and to be prepared that it will usually take longer time than expected. At the same time companies have to see it as an ever changing improvement process and there will always be opportunities to learn from mistakes and thereby improve the way of working and communicating within organizations. As for any kind of implementation, change will be inevitable. Therefore all companies should be aware of the different states/phases that an organization has to go through when changing. Management also needs to bear in mind that there will be a learning anxiety when starting, which could create some problems when implementing visualization according to LPD. Exercising a delegating and supporting leadership is also mentioned in the literature as an important part of a successful implementation. Accepting that all knowledge does not come from inside the organization is good and among the benchmarked companies different approaches had been taken; a combination of using consultants and training employees at the same time to ensure that the knowledge stays within the company is appropriate. The size of implementation differed between benchmarked companies, but the majority of them choose to start with smaller projects, pilot projects, and later let it spread in the organization. Last but not least all benchmarked companies mentioned that it is hard to measure the effect of an implementation of visualization and that the focus should instead be on "Soft values".

Research question number four *"How can MHC start an implementation of visual planning of their PD organization?"* will be answered in below chapter 7 "Epilogue: Ongoing implementation at MHC and recommendations". Here gained knowledge from the pliot- and benchmarking study together with reviewed literature will result in a framework for the future visualization work at MHC.

7 Epilogue: Ongoing implementation at MHC and recommendations

After finishing the benchmarking study, the work to build up a visualizations framework for MHC was started. As described in the method chapter this framework was created through discussions in co-operation with a reference group consisting of three line managers. Also findings from the literature study and the benchmarking study was taken into consideration when creating the visualization framework for MHC. The work with visualization at MHC already started in some groups at the same time as this thesis was initiated. The reason why these groups started was because their managers had previously taken LPD courses and considered the concept interesting and powerful.

The work with the reference group was started by a start up meeting where findings from the conducted benchmarking study were presented. To get a hint of their view of visualization we also asked each one of them to draw a picture of what they thought was important to visualize. With these inputs, together with all data gathered from our interviews and literature study, we started to work with the framework. The framework will be used in order to help MHC to spread the knowledge of visualization within their organization. This section will answer research question four: *How can MHC start an implementation of visual planning of their PD organization?*

7.1 What to visualize

The first draft was a box of corrugated cardboard where we visually made a mock up of an *Obeya.* This mock- up, Figure 9, consisted of short-, mid- and long term planning, issue/deviation board, continuous improvement board, goals and strategies, product visualization, communication board, multi project board, pulse board and a project prioritization board. This draft was presented for the reference group in order to get their comments. Comments that we got were to focus more on the line organization instead of the projects. Due to that the visualization implementation had not been initiated from top management and because of that the reference group represents only the line organization, we then concluded to focus on the line team. This made us only focus on: short-, mid- and long term VP, continuous improvement, goals and strategies, product visualization and prioritization.

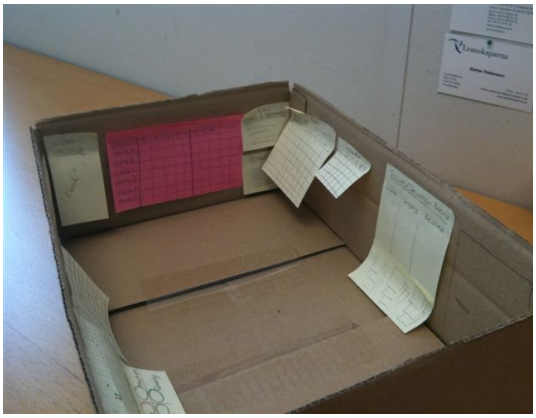

Figure 9, first mock- up of our framework

From this first mock up a visual strategy was created and discussed with the members of the reference group. Starting from the top, it consists of a multi project board, which is a Pulse board, where all projects and line teams are connected. The relation between these two should be communicated with green, red and yellow markers. This multi project board was just added in order to understand our long-term plans, and will serve as recommendations for future work. This board is divided into one project board and one group/ line VP- board. Focusing on the group/ line VP- board it consists of a short-, mid- and a long term VP. We think that the short term VP, Figure 10, should be a whiteboard or a big paper which has all team members on the rows and two weeks planning, divided into Monday – Friday on the columns. Mid- and long term planning could be on a printed paper or in an IT-system, due to that these are more static and do not have to be updated as often as the short term VP. At the short term VP post-its should be used in order to plan deliveries.

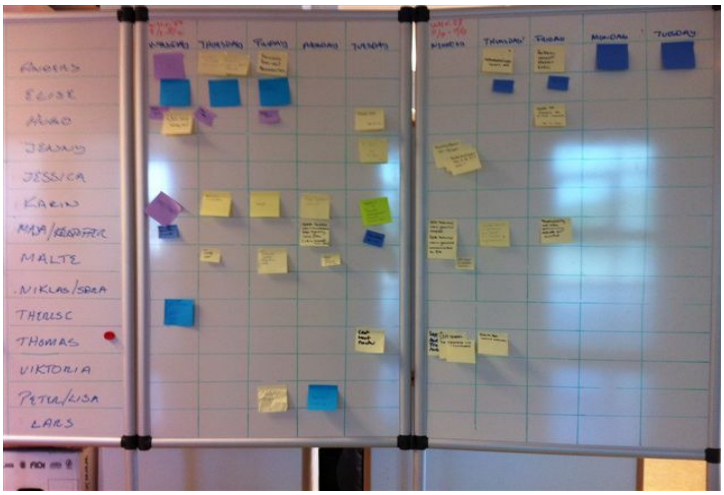

Figure 10, Short Term VP

As the literature and benchmarked companies have said, colors will be used to make it easy to see what is communicated. Therefore a color- code was created for MHC, Figure 11. From the knowledge gained in our literature and benchmarking/ interview studies we recommend that a post it color-code should be standardized within the whole MHC PD organization, for those who are working with VP. Before the color- code was set, we had some discussions around the purple and the blue post it. Due to that MHC is a global company and often people are out of office but still working. Therefore we decided to have one post- it representing vacations/ out of office and another representing business trip/ conference/ Home office.

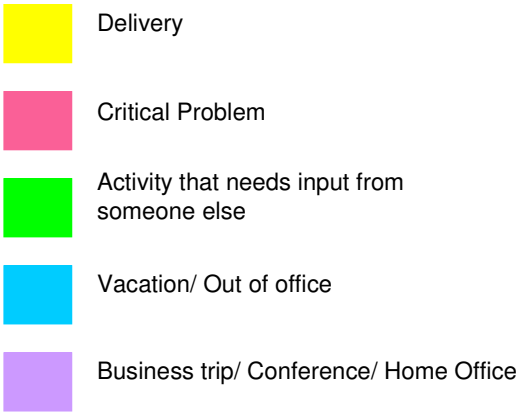

Figure 11, Color code MHC

To facilitate the VP meetings we recommend MHC to use short stand up meetings, where everyone in advance have updated their deliveries for the coming period. We recommend that these meetings are approximately 5-15 minutes and are held preferably once a week.

Moreover a continuous improvement board should also be visualized. If there are any deviations or issues regarding the group or the whole organization of MHC this should be visualized. How this should be visualized has been discussed a lot during our meetings with the reference group. The discussions have been about how to visually show all improvement suggestions. What we have seen from our benchmarking study is that both Atlet and Autoliv are using the PDCA- cycle, which visually shows the progress of a suggestion. Our suggestion was to build up a continuous improvement board as a PDCA- cycle and create a template, where each suggestion is explained. This template later follows the whole cycle through, which makes it visual and easy to follow. To

decide if a suggestion should be taken into consideration or not we discussed the use of a PICK- chart. This PICK chart was something that we had not heard about earlier, but had been used in one of the reference group members team. PICK is an abbreviation for Possible, Implement, Challenge and Kill, Figure 12. It is used in order to see the correlation between the payoff and the difficulty of a suggestion. With high payoff and low difficulty, the suggestion should be implemented.

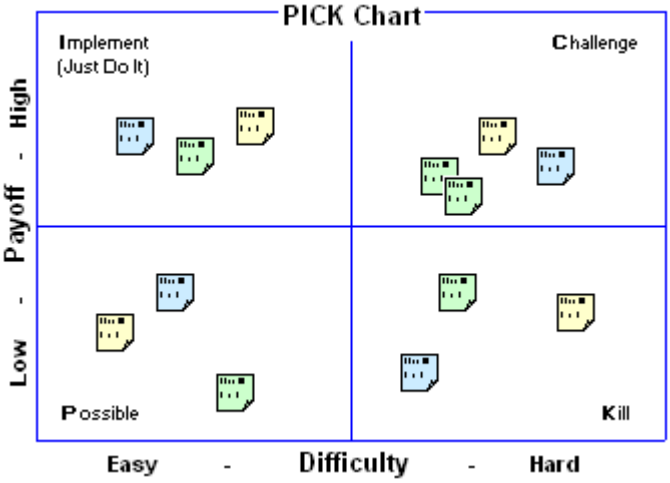

Figure 12, PICK- Chart

Since we have not seen this tool in any of the benchmarked companies, we discussed the use of it with Stefan Bükk, Swerea IVF, and Lars Holmdahl during the LPD course. Lars and Stefan argued that often decisions made according to this tool, were often taken without enough information and facts. Therefore they recommended us to not use it. We discussed this with our reference group, but they argued that it worked in their team. So we decided to keep it as a support tool, which could be used in order to get the right mindset.

Because different improvement suggestions are affecting different levels in the organization and will be posted on the continuous improvement board, our suggestion to MHC is to divide it into two different boards on different levels. One board handles problems that could be solved within the group and the other one handles improvement suggestions affecting higher levels of the organization, e.g. cross functional, Figure 13.

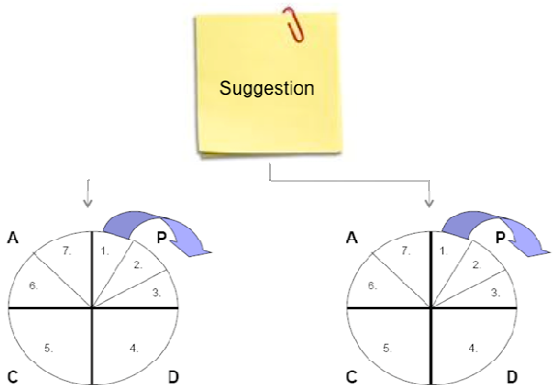

Figure 13, Continuous Improvement MHC

To understand the difference between these two improvement boards, we used an apple tree, Figure 14, created by Anders Karlsson, Global Quality Manager R&D, MHC, This tree is divided into four levels, where the two lower once represents team level and the two higher represents the management level at MHC. This picture should only be used as a guide to understand if a suggestion could be taken care of within the group or if it has to go higher up in the organization.

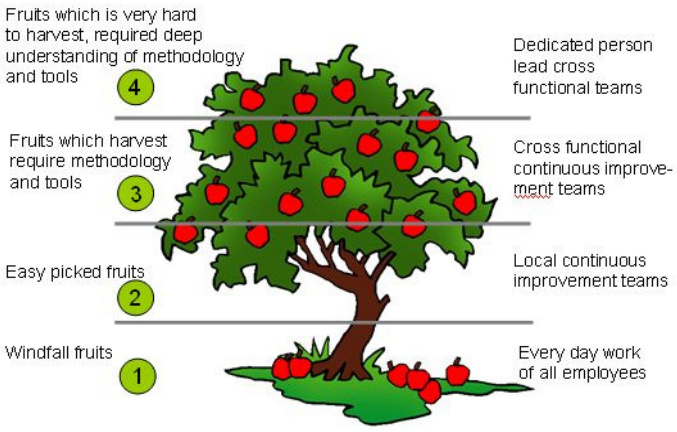

Figure 14, MHCs problem solving tree

Furthermore**,** the pilot study concluded that there was lack of understanding the prioritization of different projects within the PD organization. To clarify the project prioritization we recommend the line team managers at MHC to visualize the prioritization of all projects so that a common understanding can be gained within the whole team. This is already done today by a Project Portfolio Board at MHC, but unfortunately

the information dose not always reaches everyone affected. Also the VP could in some cases help the managers to prioritize among deliveries.

Other areas that we have seen visualized in the literature and benchmarking study are goals, strategies, core values and products or mock- ups of products, which we recommend MHC to also visualize.

7.2 How to overcome implementation barriers

At MHC the work has already started in different line teams as pilot projects and curiosity is starting to spread within the organization. We think that one success factor to continue with MHCs visualization work is to involve the Quality Affairs, QA, department as a support function, and let them spread success stories and best practices within MHC. As QA have already started using VP, Figure 15, it will give them credibility in their support function in supporting the PD organization their visualization work.

Figure 15, QA first VP meeting

What we think is important in this work is to use this framework that we created as education material to make it easier to guide new groups in their work of implementing visualization. We think MHC should set some standards, but not standardize too much, let each group that is interested in implementing visualization decide themselves. The only area we recommend MHC to standardize is the color- code. To use a standardized color- code makes it easier to understand other teams´ boards, which leads to better transparency within the whole organization. Using common symbols e.g. color- codes in the whole company will also lower the anxiety level when learning.

Communication regarding the visualization work at MHC should be spread in various ways. A combination of using formal as well as informal communication flows could be appropriate. Combining verbal, written and visual communication is to be recommended, to both talk and write down information and spreading success stories on the intranet as well as in meetings and in coffee brakes are different ways to do this. It is also important to adjust the training material according to the right level in the organization and adjusting the communication regarding if it is up- stream or down- streaming communication within the organization.

We also recommend the implementation group or manager to clearly state the current state and what the future state will look like when implementing visualization. This will help the group learn and accep the new ways of working. The leader also has to practice a supporting leadership and coach the group members to understand that failing is part of the learning process and that it is accepted by everyone.

Due to that the visualization initiative is not initiated from MHCs top management we would recommend MHC to continue the work that has been started in the line teams and let it grow in a slow but controlled way. MHC should clearly inform the organization that visualization is not something that is forced upon them, it is only a suggestion. By doing this we hope that it will create a curiosity in the organization and that it will form a need of visualization in all groups within MHCs PD organization. We do not think MHC should hire any consultants to speed up the process, consultants could instead be used when MHCs organization is ready to take the next step, to move from implementing in the line organization into implementing visualization on projects, or when making strategic visualization plans for the entire MHC organization.

If consultants should be used, we recommend MHC to work towards a “train the trainer” concept, coordinated by QA. As Kennedy argue with his knowledge arrow, it is important to keep the knowledge within the organization. To gain knowledge from a consultant is good, but the knowledge has to stay within MHC even after the consultant has left.

We also recommend from the benchmarking findings which is also stated in the literature, that people who are training others in the visualization work should try to always get support from key power groups within the company. By obtaining the critical mass in favor of this change will then

make the change process more smoothly within the PD department and it will more easily spread in the department.

As was mentioned in the benchmarking study, some companies do not focus on measurements to see results of an implementation of visualization. Instead they send out surveys to the employees to get feedback regarding "soft values", as if they feel less stressed, happier, more at ease etc. This would be an easy way for MHC to continuously get feedback from the visualization work, which could give good indications to what should be further developed at MHC when working with visualization.

As Ascom mentioned it is easy to implement visualization but harder to keep it alive in the long run. Therefore we recommend MHC to manage the problems of power, control and anxiety in order to make the change sustainable and always keep in mind that changes always takes longer then expected.

7.3 Recommendations for further work

In the future MHC could expand their visualization work to outside the boundaries of the PD department. Other functions that work cross functionally could for example use a cross functional board, Pulse boards, for visualizing how different departments works and affects each other.

Another area that is mentioned is to use a communication board. As was seen from the pilot study made at MHC, communication needed to be improved at the PD department. Therefore we recommend to use a communication board, as used by Volvo Powertrain, where they let employees send information to a coordinator that later on sorts the information according to who owns the information, who should spread the information, when should it be sent out, to whom, which priority does it have and so on. In this way the PD department will get clearer information flows and the PD employees will hopefully feel that they will get more qualitative information when given to them.

As future research areas for MHCs visualization work we would recommend them to look deeper into the following three areas: How can MHC solve visualization in their global organization?, How can MHC coordinate visualization between the line and project organization? and What common success factors are there for implementing visualization?.

8 References

Alfredson, Ludvig, and Björn Söderberg. "Pros and Cons of Lean Visual Planning- Experiences from Three Product Development Organizations." Division of Operations Management, Thechnology Management and Economics, Götegorg, 2011.

Argyris, C, R Putnam, and M Smith. *Action Science- Concept Methods and Skills for Research and Intervention.* San Frencisco, Califonia: Jossey-Bass, 1985.

Aronsson, Jennie, and Sara Friberg. *Evaluating Strategic Change Implementation- An in-dept study of communication roles during organizational change.* M. Sc, Division of Management of Organizational Renewal and Entreprenurship, Technology of Management and Economics, Göteborg: Chalmers Reproservice, 2011.

Ascom. *Ascom.* 2011. www.ascom.se.

Assarlind, Marcus, and Kristoffer Bäckman. *Combining Lean and Six Sigma in Practice.* M. Sc, Division of Quality Science, Technology Management and Economics, Chalmers Reproservice, 2008.

Atlet. *Atlet.* 2011. www.atlet.se.

Autoliv. *Autoliv.* 2011. www.autoliv.se.

Beckhard, R, and W Pritchard. "Strategies for large system Change." *SLoan Management Review*, 1975: 44-55.

Bryman, Alan, and Emma Bell. *Business research methods.* Vol. ll. Oxford: Oxford University Press Inc, 2007.

Chalmers. *Chalmers University of Technology.* 2011. www.chalmers.se.

Coutu, Diane L. "The Anxiety of Learning." *Harvard Business Review* (Harvard), 2002.

Deming, Edwards W. *Out of the crisis.* Cambridge: MIT Press, 1985.

Dow, William, and Bruce Taylor. *Project Management Communications Bible.* Indianapolis, IN: Wiley Publications, 2008.

Espling, Mats, interview by Peter Axeborn and Lisa Bjugger. *Personal Conversation* (04 2011).

Holmdahl, Lars. *Lean Product Development På Svenska.* Göteborg, Västra Götaland: Stromia Digitaltryck AB, 2010.

IVF, Swerea. *Swerea IVF.* 2011. www.ivf.se.

Kennedy, Michael N. *Product Development for the Lean Enterprise- Why Toyota system is four times more productive and how you can implement it.* Richmond, Virginia: The Oaklea Press, 2003.

Kennedy, Michael, Kent Harmon, and Ed Minnock. *Ready, set, dominate- implement Toyota's set-based learning for developing products and nobody can catch you.* Richmond, Va: Oaklea Press, 2008.

Liker, Jeffery K. *The Toyota Way- Lean för Världsklass.* Translated by Föreningen Lean Forum. Malmö, Skåne: Liber, 2009.

Müller, Ralf. "Projektplanering och Proejktmetodik." Götegorg: Müller, 2011.

Maylor, Harvey. *Project Management.* Harlow: Ashford Colour Press Inc, 1996.

MHC. *Mölnlycke Health Care.* 2011. www.molnlycke.com.

Morgan, James M, and Liker K Jeffrey. *The Toyota product development system- Integrating people, process, and technology.* New York: Productivity Press, 2006.

Nadler, David A, and Michael L Tushman. "Implementing New Design- Managing Organizational Change." Hand out in course Quality and Operations Management, 1997.

Nonaka, I. "A Dynamic Theory of Organizational Knowledge Creation." *Organizational Science*, 1994: 14-37.

Ohlsson, Tobias, and Måns Ottertun. *Nyckelfaktorer för en lyckad implementering av Lean Produktutveckling i svensk industri.* M.Sc, Avdelningen för produkt- och produktutveckling, Maskinteknik, Göteborg: ChalmersReproservice, 2008.

Oosterwal, Dantar P. *The Lean Machine- How Harley-Davidson drove top-line growth and profitability with revolutionary lean product development.* New York: American Management Association, 2010.

Lean i tjänstemannaproduktion. Performed by Stefan Peterson. Kungsbacka. 2011.

Söderberg, Björn, interview by Peter Axeborn and Lisa Bjugger. *Personal Conversation* (04 2011).

Söderberg, Björn, and Ludvig Alfredson. *Building on Knowledge- An analysis of knowledge transfer in product development.* M. Sc, Division of

Operations Management, Department of Technology Management and Economics, Göteborg, Västra Götaland: ChalmersReproservice, 2009.

Scania. *Scania.* 2011. www.scania.se.

Shiba, Shoji. "The steps of KJ- Shiba Methods." Hand out from cours in Quality and Operations Management, 1985.

Ward, Allan C. *Lean Product and Process Development.* Cambridge, MA: The Lean Enterpris Institute, 2007.

Wheelwright, Steven C, and Kim B Clark. *Revolutionizing Product Development- Quantum Leaps in Speed, Efficiency, and Quality.* New York: The Free Press, 1992.

Volvo. *Volvo.* 2011. www.volvo.com.

Womack, James P, Daniel T Jones, and Daniel Roos. *The Machine that Changed the World.* New York: Free Press, 1990.

Appendix 1- Pilot Study

Guideline questions which were used during the pilot study interviews at MHC.

1. How is your workspace allocated?

2. Do you work mostly in team or individual?

3. What would you say about communication within MHC and how does it affect your daily work?

4. Sometimes projects succeed and some times they fail, can you give some factors that affect this outcome?

5.1 Are there different categories of projects within R&D and what are they called?

5.2 How do you follow your project plan and are the projects delivered on time?

6.1 Who is involved in the decisions made during the project? Who makes the final decision?

6.2 On what information are the decisions in the R&D toll gates being made?

7. Do you use any tools or methods to help you in the R&D decision process?

8. Are things like knowledge, learning's and experiences transferred between projects?

9. In your R&D projects, how do you manage risks?

10. What kind of problem do you face during the R&D process?

11. Who do you see as your client?

12. How do you manage client's inputs?

13. Do you see the R&D process as a push or pull way of working?

14.1 Do you know any aid/ tools to help you secure quality in the R&D process?

14.2 Do you use any of them in your daily work?

15. Have you previously used any quality aid/tools or work methods that you think are suitable for MHC?

16. Do you know any company/ business that inspire you within the area of quality and R&D?

17. Do you have any needs that you would like us to fulfill within the area of quality and R&D?

18. Anything to add?

Appendix 2- KJ-Shiba method

Guide to how a KJ- Shiba brainstorming is conducted step by step.

Step 1 – Prepare a large chart

Make a wide chart, put it up on the wall and write the theme at the top expressed as:

-"what is (was) the biggest problem in your.."

-"what is (was) the most difficult problem in your.."

Step 2 – Warm up

Hold a free discussion on the topic for five minutes while the team, consisting of 4-7 people, sits close together facing the board or wall while the leader sits at the right hand of the table.

Step 3 – Distribute labels

The leader hands out 20 or so labels to the team and the total amount of labels should not be less than 19 or exceed 24.

Step 4 – Recording the problem

Each member writes down problems or ideas using a black marker, putting one problem on each label in a short and concrete sentence not more than four lines. The sentences should be facts, multi valued and as specific as possible, when finished the labels are put on the chart.

Step 5 – Clarifying the meaning

The leader puts one label at the time in focus and the author of the label explains it to the rest of the group, any corrections are made with a red marker. The discussion should be on conveying the same message to everyone in the group and not whether the statement is right or wrong. This is done with all labels and it is the most important step so as much time as needed should be taken.

Step 6 – Label grouping

Arrange small groups of the labels with similar meaning, not having more than three labels in each group, some labels may not fit into any group. Everyone should participate in the grouping process and listen to each label without prejudice, but instead rely on intuition and feeling instead of logical connections. Labels should not be grouped together based on similar words or subjects and beware of choosing labels based on stereotyped ideas.

Step 7 – Check for omissions

If the team agrees on something important being left out, add one or two labels.

Step 8 – Title making

Write a title for each small group with a red marker, the title should be a short sentence which represents the meaning and state. The labels that did not fit into any group remain without title.

Step 9 – Second level grouping

Second level groups is a grouping step according to the similarity of meaning of titles, which is the only object in focus. The titles may be of any small groups or separate labels.

Step 10 – Title making for second level groups

Make the title for each second level group using a blue marker and the approach is the same as the first level title making.

Step 11 – Layout

Groups and the single labels should have been reduced to 5 or less and the elements should be laid out according to the relationships between them. Draw symbols on labels and position them to shown relationships between them.

Step 12 – Disintegration

When the elements have been positioned, disintegrate the second or higher level groups in turn and circle them in a pencil.

Step 13 – Paste labels

Paste the individual and first level title labels exactly where they have been placed, the second level titles should not be pasted and everyone should join at the board.

Step 14 – Outline the first level groups

Draw a line between with a black marker round the labels linking in the title.

Step 15 – Outline the second and third level groups

Encircle the second level groups with a green marker and write the second level titles round the top with a blue marker. Repeat for any third level groups still using a green marker.

Step 16 – Show connections

Draw arrows between elements with a red marker.

Step 17 – Evaluation

Each member votes for three titles in order of importance. The leader hands out three colored spots where the color red is equal to 3 points, blue is 2 points and green is one point. All vote simultaneously by sticking the spots on the corner of the titles and votes must be only for titles of the first level groups or the single labels.

Step 18 – Highlighting the results

The groups are sorted according to the score and a short sentence giving a condensed statement of the problem is written.

Step 19 – Finishing off

Write in black the date, place and participants on the chart.

Appendix 3- Benchmarking

Guideline questions which were used during the benchmarking study of five Swedish companies and two Swedish researchers in the area of LPD.

Interview with Benchmarked companies

1. Why did you implement visualization according to LPD?
2. Key-findings when implementing?
3. What was the timeframe for the implementation of visualization according to LPD in your company?
4. What was the size of the implementation in your company?
5. Which tools and methods were used?
6. What have you chosen to visualize in your company?
7. How did you get people interested in the visualization work?
8. How do you solve the global aspect of visualization in your company?
9. How do you communicate in your company?
10. What results have you seen from the implementation of visualization according to LPD in your company?
11. How do you measure improvements of visualization according to LPD in your company?

Interview with benchmarked researchers

1. What experience do you have of implementing visualization according LPD?

2. Which companies have succeeded in successfully implementation of visualization according to LPD? How have failed? Reasons for this?

3. Key-findings for an implementation?

4. Which are the most common reasons to why companies chose to implement visualization according to LPD?

5. Which areas should be visualized and communicated?

6. How do you visualize according to LPD globally e.g. Obaya-room?

7. How should a visualization board be structured according to LPD? Most common areas to visualize?

8. What should, according to you, the estimated timeframe for an implementation of visualization according to LPD be?

9. How do you think the size of the implementation should be? What should you start with?

10. How do you get people interested to change? How do you succeed?

11. What results have you seen from an implementation of visualization according to LPD in companies?

12. How would you measure improvements of visualization according to LPD?

13. What tools and methods have been used when working with visualization according to LPD?

Appendix 4- Key findings from benchmarking study

Key findings from benchmarked companies

	Ascom	Atlet	Autoliv	Scania	Volvo Powertrain
1. Why did you implement visualization according to LPD?	• Wanted to implement LPD • Visualization was the easiest to start with	• Needed to become more competitive	• It sounded interesting and we wanted to try something new	• Needed a better understanding of what we were working on	• Volvo Groups top management set up improvement goals for all Volvo companies where visualization is one tool that is used
2. Key-findings when implementing?	• People need to be interested and motivated • Think cross functional • Start small (pilot projects) • Do not push methods	• Top management support • Using consultants	• Patience • Keep it simple • Balance between culture-structure-methods-tools	• Keep it simple • Focus on deliverables • Focus on individuals • Let failing be a part of the learning process • Use common sense	• Create the right mindset • Identify what waste is for US • Focus on value adding activities • Do not standardize to much • Set up long- and short term goals
3. What was the timeframe for the implementation of visualization according to LPD in your company?	• It takes time, be patient	• 6 month timeframe for the visual planning boards (KI-VP boards)	• Pilot projects during 1 year, then the whole company	• It is a continuous work • For one group it took over one year before they felt comfortable	• Implemented VP 1.5 year ago and are still learning

4. What was the size of the implementation in your company?	• Started in the top management group and then let the ones who are interested start	• The Lean approach on appx. 200 persons • KI-VP boards on appx. 70 persons	• One initiative started in production • The other initiative came from top management	• Started on pilot projects and then let it spread in the company over time. (Started with the persons who are interested)	• One initiative started in production • The other initiative came from top management
5. Which tools and methods were used?	• Improvement A3 sheet based on the PDCA/LAMDA- cycle • KJ-method • 8D method	• A3 • 5S • 5Why • KI-VP • FMEA • PDCA	• We have tried everything, for example A3, PDCA etc.	• Whiteboards • A3 • Be innovative! Use tools that suites your needs.	• Communication boards • A3 • Root cause analysis • 8D method • Cost of poor quality etc.
6. What have you chosen to visualize in your company?	• Short-, mid- and long-term planning boards • Pulse board • Activities • Planning • Project portfolio • Synchronization board • Prototypes	• Short-, mid- and long term planning boards • KI-VP boards	• Nothing common in the company, everyone can visualize what they want and need • Short-, mid- and long term planning boards	• Time plan • Continuous improvement board • Project board • Products • Prototypes • Deviations	• The top five priorities in a project • Communication board • Problem board (Daily team leadership)
7. How did you get people interested in the visualization work?	• Give managers education • Spread knowledge between groups	• The management team did benchmarking visits • Using consultants • Educate employees in Lean • Let people vent motions and thoughts • Inform about the implementation	• Be clear about what is going to be implemented • Communicate were we are & what the goal is • Have activities • Coach employees • Use external help (consultants, lecturers)	• Using "train the trainer"-concept Having a 6h training to show the strength with VP	• Use a combination of top-down & bottom-up approach • Work more pull, support employees. • Do not force tools & methods • Create a need for changing • Communicate were we are & what the goal is

8. How do you solve the global aspect of visualization in your company?	• We copy some boards in to an Excel sheet • Some call in to VP meetings from abroad	• They have common folders in the intranet which everyone can access • The whole R&D department is centralized in Gothenburg	• According to our experience it is not possible to visualize according to LPD globally	• The whole R&D department is centralized in Södertälje • Use some IT-solutions when needed	• They allocate employees when having Obeya-meetings • Using different types templates and information documents of that are copies of VP-boards
9. How do you communicate in your company?	• Through short meetings • Visualizing in a simple way so that everyone understands	• Daily meetings in front of the KI-VP boards • Employees can easily find info. On the intranet	• Cross functional teams sitting close to facilitate the communication	• By having short and regular meetings • Communicating lessons learned • Communicating deviations	• Communicating visually, mail, intranet, team place, face-to-face conversations • Spread information once per week through to everyone concerned
10. What results have you seen from the implementation of visualization according to LPD in your company?	• Better general knowledge and information flow • Better common understanding • Easier to find info. • Short & effective meetings	• Better common understanding • Better overview • Faster problem solving • Faster decision making • Increased responsibility	• Improvements suggestions • Better common understanding	• Better common understanding • Faster and better problem solving and identifying deviations • Faster decision making • Clearer responsibility roles	• Better common understanding • More effective meetings • Better identification of waste
11. How do you measure improvements of visualization according to LPD in your company?	• We do not measure but people seem to be more engage in their work, better attendance on meetings. To total improvement is big.	• Looking at the delivery precisions of our products to our customers • Number of incoming improvement suggestions Vs. Implemented suggestions	• Number of incoming improvement suggestions Vs. Implemented suggestions • Otherwise they do not measure	• It is not important to measure • Measure more on the whole picture e.g. employee satisfaction survey	

Key findings from benchmarked researchers

	Stefan Bukk	**BjörnSöderberg**
1. What experience do you have of implementing visualization according LPD?	• Companies seldom fail • If they fail its often due to that they are using to strict models (consultancy firms) • Adjust the organization to the company culture, not the other way around	• Important to get support from top management • To much focus on standardization when implementing have often let to failure (consultancy firms) • Everyone needs to understand "What's in it for me?"
2. Which companies have succeeded in successfully implementation of visualization according to LPD? How have failed? Reasons for this?	• Succeeded: AskoCylinda, SAAB Military aircraft, SKF, Scania, Ascom • Focus on: "Management by needs", Corevalues-principles-methods-results	• Succeeded: Autoliv, Scania, SAAB aeronautics, Ascom, Atlet
3. Key-findings for an implementation?	• See it as a constant transformation • Respect your people • Listening leadership, walk around	• Build in right values • Make people understand "What's in it for me" • Focus on deliverables • Start with pilot projects
4. Which are the most common reasons to why companies chose to implement visualization according to LPD?	• Simple to implement • Common understanding • Effective planning tool	• 50%Easiest way to start working with LPD • 50% R&D gets interested after that production have used it
5. Which areas should be visualized and communicated?	• Time plan • The goal (group/project/company)	• Deliverables • Continuous improvements • Processes
6. How do you visualize according to LPD globally e.g. Obaya-room?	• ABB uses an electronically pulse boards, Lotus Notes-database	• Have not seen any good solutions to this problem yet • IT-systems could be helpful
7. How should a visualization board be structured according to LPD? Most common	• Projects Vs. Line organization (pulse board, Scania)	• Short-, mid- and long term plans • Days Vs. Persons

areas to visualize?		• Deliverables
8. What should, according to you, the estimated timeframe for an implementation of visualization according to LPD be?	• Set up goals for every 100 days. See it as a constant transformation	• Give it a lot of time and patience • It always takes longer time than you expect
9. How do you think the size of the implementation should be? What should you start with?	• Start with not more than 2 to 3 things at the same time	• Start with the ones who are interested • Start with pilot projects
10. How do you get people interested to change? How do you succeed?	• Start with something small that has a high successful rate • Spread success stories • Support continuous improvement – failing is accepted	• Educate employees • Communicate benefits and effects from visualization • Let someone with experience inspire others
11. What results have you seen from an implementation of visualization according to LPD in companies?	• Common understanding has increased • Handles delays in a better way • More effective resource utilization • Better frontloading of projects	• More effective resource utilization • More effective and shorter meetings • Common understanding • Better problem solving • Faster decisions
12. How would you measure improvements of visualization according to LPD?	• Hard to measure. Should instead evaluate the improvement work	• Hard to measure LPD work. • Sometimes estimations can be useful
13. What tools and methods have been used when working with visualization according to LPD?	• LAMDA and PDCA- cycles	