

Visual Planning: Coordination and Collaboration of Multi-site Teams in Product Development Organisations

Master of Science Thesis in Production Engineering

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Abstract

When products are becoming more complex and their life-cycles become shorter it sets higher demands on product development within companies. Also, it is becoming more common for companies to have multi-site projects where team members are divided between different geographical locations. A method for planning and synchronising projects is Visual Planning, from Lean Product Development, which have strong benefits in its simple design. Normally the only resources demanded is sticky notes, some pens and a wall to place the notes on, but when including several sites in projects and demand that they all should work as one team the physical solution with sticky notes cannot achieve desired results.

The purpose of this study was to address how Visual Planning can help a multi-site team within product development to succeed, and has strived for finding every day, practical solutions. The research within the area is limited, especially on *how* to achieve the benefits of Visual Planning. The study has therefore included interviews, and in several of the cases observations, from ten companies and with an expert of Visual Planning to gain a practical approach on *how* Visual Planning can help a team to succeed. One of the companies included has been the case company, Emerson Process Management, which is a global company that has used Visual Planning for about a year. The use of a case company gave the opportunity to interview and observe teams within product development over time, and to verify information gained from the field of research and the reference companies through performing tests.

The study has shown that Visual Planning can help a multi-site team to succeed, and also includes new findings on *how* it can be accomplished. Visual Planning fills its purpose well for teams that need coordination and/or collaboration, and Visual Planning enables a structured way of visualisation and communication. The main difference between a multi-site team and a single-site team is that nothing is gained for free, such as small chats by the coffee machine, so the structure of Visual Planning is a way to ensure that necessary communication between sites occur. Also, for receiving the benefits of visualising information in multi-site teams, the whole team need to be able to see and interact with it and therefore a digital tool is recommended instead of sticky notes. In this study the digital tool Yolean has been chosen which was developed to support the methodology of Visual Planning.

Key words: Visual Planning, Multi-site teams, Virtual teams, Distributed teams, Digital Visual Planning, Virtual Visual Planning, Lean Product Development, Project planning, New product development, Visual Management

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1 Introduction

The introduction will present the purpose and real world connection of the study. It will also give a quick tour of Visual Planning and what is presented in this study.

In a world that is moving at an increasing rate it becomes continuously tougher for companies to compete. Products are becoming more advanced, but at the same time they have to be delivered faster, at a better quality, and at a lower price. Lean production is a common process used in the industry to try and meet those demands, but the challenges are not only in production. The lifecycle of products becomes shorter and new products has to be put on the market at a faster pace (Liker, 2004) and it sets new demands on product development. Projects become larger as the products become more advanced and it is not unusual to have several different sites involved. This in turn set new demands on the teams that have to create the new solutions. These teams cannot work in the same way that they always have, but need to develop new procedures.

If Lean philosophy has been introduced to a company's production it can seem logical to introduce it to the product development process as well, but according to Lindlöf & Söderberg (2011) lean within product development is not as far developed as in production. The field is growing, but there are large differences between production and product development so how the values of lean production should be interpret for lean product development is not always clear. Mascitelli (2011) considers product development to be a combination of both process and project, and more dynamic than production. It becomes clear when comparing planning in production to planning in product development. Large parts of production can be standardised and lead times are often known and therefore schedules can be set for a week forward, or perhaps even a month depending on the market of the company. In product development there can be years from idea to product delivered to customer therefore the process in projects is never exactly the same. The activities are not the same in every project and even those that are can have different durations depending on the size of the project. Companies have to learn what is common between projects to be able to partly standardise the product development process otherwise it is almost impossible to create correct time plans and set delivery dates. Also, unlike in production where the team is constant product development continuously have new constellations of teams and therefore team structure and standards has to be set every time.

Tools including visualisation are powerful since they can deliver instant overviews of situations (Liker, 2004). Therefore Visual Planning has been developed within Lean Product Development (LPD) to help with project planning. With Visual Planning an overview of involved departments, dependencies between tasks, necessary input to projects and opportunities for communication can be displayed. Strong reasons for using Visual Planning is its ability to deliver solutions for communication and coordination (Lindlöf, 2014).

Two important parts for the structure of Visual Planning is the VP-boards and the meetings connected to them. In simplicity the VP-boards display different tasks of a project, when they should be done, what other tasks they depend on, and who should perform them, see Figure 1-1. The meetings are held to update the VP-boards and inform of any issues that has arisen. In a project there are often three time-horizons present; long-term that give an overview of the entire projects and the horizon is often years ahead, mid-term that display what should be achieved in the next couple of months, and

short-term that displays what will happen in the nearest weeks. Normal materials for VP-boards are sticky notes, pens, large paper and a wall, but when more than one site is involved in a project all members can no longer interact with it since only team members at one site can move and

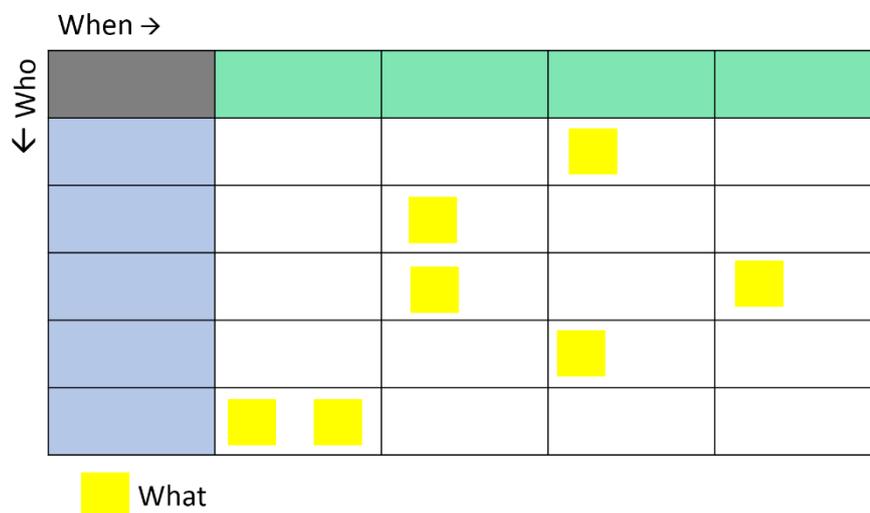


Figure 1-1: A simple representation of a VP-board

write/update notes. Also coordination and communication is hindered since everyone in the team cannot gather around the VP-boards during meetings.

1.1 Purpose and Aim

The field of research concerning Visual Planning used in projects having multi-site teams is, to a large extent, uncharted territory. Most research done is directed towards the purpose of Visual Planning rather than practical adaptations of it. The purpose and aim of this study has therefore been to gather results from three different areas; the research community, reference companies that have knowledge of visualised planning, and testing at a case company who has recently started to use visual planning in projects and for multi-site teams. Together the results has given input to how Visual Planning can be used to support multi-site teams both concerning the methodology and how to overcome practical issues with split teams which Lindlöf (2014) specify as an area in need of research.

1.2 Method

To fulfil the purpose of the study research questions are presented in 1.3.1 Research questions. These are then answered in two steps; firstly with theoretical input from research within the field and practical input from reference companies; secondly through testing in PDCA-cycles at the case company based on the previously gathered information to ensure that results from the study has practical use.

1.3 Description and formulation of the problem

The case company Emerson Process Management's offices in Göteborg, Jönköping, and Linköping has used Visual Planning for the past year and the overall response has been positive. Issues that has been noticed concerning the use of Visual Planning is trouble to connect the different VP-boards with the different time horizons to each other and knowledge of what information to share on the board and their level of detail. Other issues that has been mentioned are only connected to Emerson's multi-site

teams; the VP-boards are located in Göteborg so other sites do not have access to them; coordination and conveying information between sites is hard with current equipment; during meetings participants at sites with fewer team members can feel forgotten.

1.3.1 Research questions

Based on information found at Emerson a description of the problem can be summarised to:

RQ: How can visual planning help multi-site teams to succeed?

To answer the question above two sub questions (1 and 2) have been formulated:

RQ₁: How can visual planning help a team to succeed?

RQ₂: How can differences between single-site teams and multi-site teams be addressed?

1.4 Delimitations

Management has to plan projects depending on resource capacity and unfortunately too many projects are often started within the area of product development and it has a direct effect on individual projects outcome (Mascitelli, 2011). Still resource planning has been delimited since it has different use and adaptations of Visual Planning when comparing to project planning.

Concerning testing at Emerson constraints has mainly been set due to the time limitations of the study, 20 weeks. The study includes little on creation of long-term and mid-term plans. Also for simplicity only the sites in Göteborg, Jönköping and Linköping has been included in the study even though there are projects at Emerson that span several continents. Thereby large cultural differences has been avoided and of course troubles arising with time differences.

1.5 Outline of the thesis

The Introduction leads into the chapter Method which should ensure a level of credibility to the data collected and conclusions made. A *Frame of Reference* and a chapter with information concerning tools for project planning follows to ensure that later chapters can be understood and validated. Then empirical findings from Reference companies and the Case company Emerson, follows. An analysis of previous chapters is presented in *Wishes, Challenges and Possible Solutions within Emerson*. The chapter set the frame for the following chapter *Tests performed at Emerson* which also include findings and analysis of tests performed. In *Analysis and Discussion* the sub-research questions are answered and the study's results for general purpose and future research is discussed. The *Conclusion* delivers a short answer to the overall research question and a table of practical solutions for how to succeed with multi-site teams.

2 Methods

The study aims to have practical results with findings not only from previous research within the field of Visual Planning and multi-site teams, but also from the industry. Therefore this study aligns well with Real world research which represent an interest of solving problems, and to gain robust results, feasible changes, adapt to time and cost constraints and orientation to a client's needs (Robson, 2011). Important to the quality of Real world problem-based research is that it has a scientific attitude, i.e. the research is carried out systematically, sceptically, and ethically.

This chapter is divided in three parts; first theoretical explanation of chosen research design; secondly how the design has shaped the study; and ends with how the study has been kept valid and reliable.

2.1 Research design

Robson (2011) states that research design is how research questions are turned into projects. Common methods to use in a Real world research are: observations, interviews, questionnaires, and testing (Robson, 2011). To answer in the study stated research questions in a scientific sense, a design of the project has been chosen to support this which is a flexible design. Flexible design supports the use of multiple data collection techniques and fit well with a case study (Robson, 2011). Since the study includes testing in a real setting within a case company, Emerson, the approaches action research and evaluation research has been included as complements to the flexible design.

2.1.1 Flexible design

A flexible design mainly considers quantitative data and the design emerges during the study. When a flexible research study is performed it is important to take responsibility to verify the authenticity of the data, be open minded as researchers, ask questions, and to be adaptive and flexible. This is especially important as there is a risk to be bias in flexible design research, due to there often being a close relationship between the researchers and participants. The design of flexible research includes purpose, conceptual framework, research questions, methods and sample procedure, Figure 2-1 **Error! Reference source not found.** The *purpose* defines what a study is trying to achieve and why, while the *conceptual framework* refers to relevant theory and the main areas that should be studied and their relation to each other. The conceptual framework, or rather the development of it, help the researcher to be specific on what should be done and what is important, but it also gives the researcher an idea of what data is needed. The conceptual framework is also important for handling



Figure 2-1: Framework for flexible research design. Adapted from Real World Research (Robson, 2011, pp. 71-72)

validity. (Robson, 2011)

The *research questions* define the project, set boundaries, and give direction of what should be achieved (Robson, 2011). Within flexible design the research questions are continuously improved, as implied by the arrows in Figure 2-1 (Robson, 2011). The research questions also work as the foundation for the development and the evolvement of *methods* and *sampling procedures* (Robson, 2011). *Methods* refer to the specific techniques that will be used to collect data and how it should be analysed, while *sampling procedures* include where, when, and from whom data will be collected (Robson, 2011). Prior to the data collection takes place should it be decided how gather information should be analysed (Bryman & Bell, 2011; Robson, 2011). Otherwise it is a large chance to end up with a lot of information but no time or resources to use it (Robson, 2011). Bryman and Bell (2011) highlight that the way data should be analysed must match the data collected, both its type and its quantity.

A flexible design can include a case study as method to reach results. Yin (2013, p. 16) describes a case study as "... an empirical inquiry that investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident.". A strength of case studies is that it triangulates data from several sources (Yin, 2013).

2.1.2 Action research

Practical problems can be addressed quickly through action research (Robson, 2007). Making continuous improvements is therefore a key factor within action research together with involvement from researchers and the researched (Robson, 2011). Action research can be combined with Evaluation research which Robson (2011, p. 176) describes as "...to assess the effects and effectiveness of something...". Action research is usually performed as a cyclic process which involves planning a change, test and observes it and then evaluates and reflects upon it, before suggesting improvements for the next cycle (Robson, 2011; Kemmis & Wilkinson, 1998). This cycle process have similarities with the PDCA-cycle (Plan-Do-Check-Act). PDCA-cycles can solve complex issues by addressing one problem at the time, and learn from the previous cycle to the next (Bergman & Klefsjö, 2010). A PDCA-cycle is a more common notion for the PDSA-cycle (Plan-Do-Study-Act), developed by Deming (Bergman & Klefsjö, 2010).

2.2 Research process

The research process and the research questions have evolved iteratively as flexible design and action research suggest. This study consists of three major parts: frame of reference, reference companies and a case company, which are analysed though triangulation to gain support for the answers to the research questions from different sources, Figure 2-2. The data has been analysed iteratively during the research to know identify knowledge gaps within the three areas. To facilitate the analysis the data have been summarised to identify the most relevant aspects for Visual Planning for multi-site use, and to help to answer the other research questions. The final analysis has been made at the test period to answer the research questions. The analysis has been discussed firmly by the researchers and end up in a conclusion of the study and recommendations to the case company on how they should proceed their work within Visual Planning.

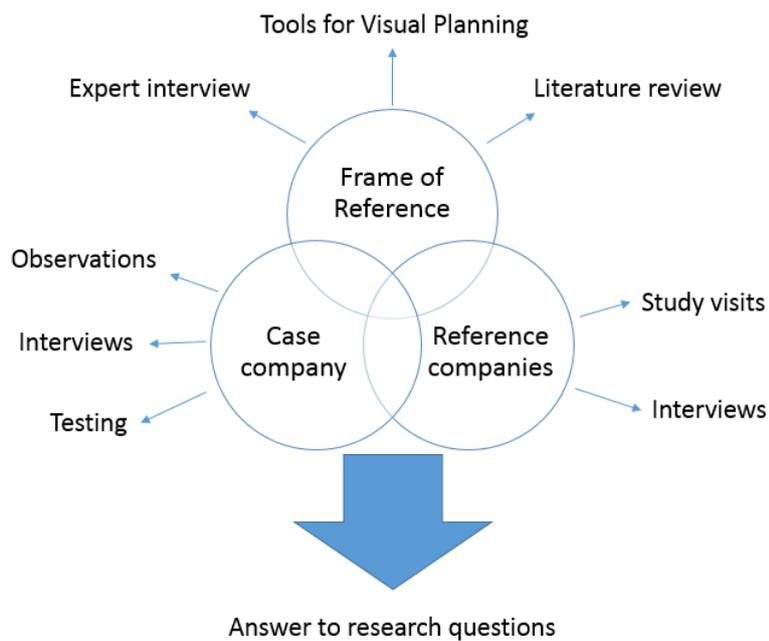


Figure 2-2: The three major areas involved in the study, which through triangulation gives answers to the research questions

The main parts of the frame of reference, case company and reference companies will be covered below. The literature review, interviews, observations and testing will be future described in chapter 3 through 8.

The *frame of reference* was the foundation for the study, and primarily consists of a literature review. It is based on the conceptual framework and has evolved during the study as the research questions have been made clearer. The conceptual framework included, but was not limited to: Visual Planning, succeeding as a team and how to work with multi-sites. Due to Visual Planning at multi-sites is a quite new subject the literature review has been complemented by an interview with an expert within Visual Planning. He has many years of experience within Visual Planning from numerous of different companies and gave valuable practical input to the study, which was something that the literature within the field where weaker within. The literature mainly focused on the strength of Visual Planning, but not in extend on how these benefits could be gained in a practical settings.

To make the reader familiar with the subject, and the notions and methods used at the reference companies, an introduction to the field of research has been included in the frame of reference. To further support the reader an extra chapter has been included. Chapter 4 present tools used for project planning. However, the information has been limited and shorter interviews with two users has therefore been included for one of the tools. These interviews contributed to a practical understanding of this specific tool.

The *reference companies* and the *case company*, Emerson, gave practical input to the study on how Visual Planning is used today at different companies and context, and what they highlighted as important factors. The participants in the study is anonyms in the report, and referred to with role, location and company name. The case company gave the opportunity to observe how the company uses Visual Planning and to test and evaluate ideas about Visual Planning from the frame of reference and the reference companies in a real context. In addition have a diary been kept of the researchers'

impressions and insights, and notes has been taken during tours at the visits to the reference companies and observations and through informal conversations at the case company. These are all known methods used in an action based research according to Bryman and Bell (2011).

The *reference companies* involved in the study are eight different companies. The majority of the interviews have been site interviews, including a tour within their facilities, however two of the interviews were performed over distance. It was considered important to include several companies in the study to gain information about how different companies uses Visual Planning, especially as the literature within this field is somewhat limited. Interesting aspects have been: single and multi-site and what they highlights as important to be able to succeed with planning. The reference companies have been chosen based on that they have been recognised for their work within Visual Planning or/and are a global company where there is likeness for distance collaboration, Table 2-1.

Table 2-1: The reference companies within the study, described with in the study involved location, function/roles and how the information where gathered.

Company	Location	Functions/Roles	How
<i>Assa Abloy</i>	Stockholm	Global Lean Innovation Manager	Skype interview
<i>Autoliv</i>	Vårgårda	Product Development	Visit and site interview
<i>Ericsson</i>	Borås	Software Development	Visit and site interview
<i>Rejmes Car</i>	Halmstad	Head of Production Control	Visit and site interview
<i>Scania</i>	Södertälje	Process Development	Phone interview
<i>Uni Carriers</i>	Göteborg	Design Engineer and Lean Manager	Visit and site interview
<i>Volvo Cars</i>	Göteborg	Operational Development	Visit and site interview
<i>Toyota Material Handling</i>	Mjölby	Product Development	Visit and site interview, phone interview

2.2.1 Literature Review

Robson (2011, p. 51) defines literature as “...what is already known and written down, and relevant for your research”. There are many reasons to perform a literature review, and some of them are to find and review what is already known within the subject to gain understanding, help defining the project’s terminology, identify knowledge gaps and different views, but also to gain credibility for the research (Robson, 2011; Bryman & Bellman, 2011). The literature review should support the development of conclusions in the research (Bryman & Bell, 2011, p. 94)

The literature has been searched and reviewed in a similar way to how Bryman and Bellman (2011, p. 110) suggest, which includes read books and/or articles recommended by others which are relevant for the field of study, keep notes of what have been read and how it will be useful, note keywords, read titles and abstracts to see its relevance. The starting point has been articles and literature suggested by the supervisors about the subject “Visual Planning”, and then studying relevant literature that has been referred to in those. Literature and articles have been accessed through the university library, which has access to many major electronic databases and google scholar. In the beginning of the study emphasis has been on literature within Visual Planning, to be able to first define what it is and to see what already have been studied about teams and multi-sites when Visual Planning has been used. To gain knowledge about what make a team succeed and what is important to consider when working with multi-sites has also been included in the literature search and review. Bryman and Bell (2011) stretch that the literature review is a continuous process, and the literature review has been written in stages. For instance has it been updated continuously to involve new concepts that had

been highlighted through interviews at the reference companies. In addition have literature been reviewed about different kind of methods and frameworks for and within visual control and agile development. But also have tools used for these context been studied, for instance sticky notes notes and some software.

2.2.2 Interviews at the case company and the reference companies

Bryman and Bell (2011) highlight the importance of flexibility during an interview in a quantitative study, and to capture the interviewee's view of the world. The interviews at the case company and the reference companies differed as the researcher had much more knowledge about the case company than the reference company prior to the interviews. In addition, the interviews at the case company where performed in a meeting room while the interviews at the reference companies where performed walking around in the facility to see their different visual planning boards and meeting rooms. A minor survey was also included at the end of the interviews, which was a way to try to get quantitative answers from the interviewees which would make the analyses easier. No transcription have been made, and Bryman and Bell (2003) then suggest that the interviews should be summarised and verified by the interviewee. All interviews have been summarised and those summaries have been sent out to the interviewees to check the accuracy.

The interviews at the case company where performed in a semi-structured way. Semi-structured interviews allow the researcher to use a guide of questions, and at the same time adapt them during the interview and ask follow up questions (Robson, 2011). It is important to make sure that the interviewee guide reflect and answers the research questions (Bryman & Bell, 2011). By using semi-structured interview can the interview be adapted to the context, but at the same time follow the main structure of the other interviews to make the analysis easier. As all gathered information, or at least all relevant information need to be compiled, organised and analysed. Within the case company was in total fourteen interviews performed and among the interviewees where there both project leaders and project members from different disciplines and sites, i.e. Göteborg and Linköping. These interviewees were between 25 and 50 minutes, and were recorded after permission by the interviewee. The recordings have been used as backup and to check citations, and detailed notes have been made during the interviews. To make it possible for the interviewer to focus on what is being said and to ask follow up questions, as recommended by Bryman and Bell (2003), have there always been two interviewers at the interview. One has hold the interviews and asked the questions, and the other has taken the notes.

The reference companies have applied visual control and Visual Planning in different ways and in different organisations and therefore was there a need to understand the overall context as well as how they worked with Visual Planning. An interview guide was therefore used more as support than as the foundation for the interview which it is in a semi-structured interview. In addition where these interviews usually performed walking and/or standing in their facilities and more similar to an open conversation than a typical semi-structured interview. These are some reasons for why the interviews were not recorded, it felt unpractical and that there was a risk that the interviewee would feel uncomfortable. The interviews were documented with detailed notes during the interview, some photos, and the interviewers discussed, and documented, afterwards some highlight from the interview. The obvious main difference between the site interviews and the phone/skype interview was the lack of actual seeing the Visual Planning and the interviewee. During the second distance

interview had the researcher gained access to a presentation that the interviewee could speak about, which made it possible to have a quite structured interview and to see there Visual Planning.

2.2.3 Observations at the case company and the reference companies

Observations have been used at the case company to complement the interviews, and to better understand how they use Visual Planning, and to observe the teams' social interaction. The case company uses Visual Planning in projects, and have several different kinds of meetings for them. To get a coherence picture of how the case company uses Visual Planning has different types of meetings, and different teams been observed. According to Robson (2011) gives informal observations the researcher the freedom to choose what information that is collected during the observation, and the pure observer should not interfere in the setting. The benefits with these approaches are that they make it possible to catch as many aspects as possible, and to analyses the ordinary, current situation and context. This reduces the risk of eliminating some important aspects in advance or affecting the normal state (Robson, 2011). However, observation templates have been used, which has similarities with formal observation, but these has only been for support and to make sure to cover similar aspect at the separate observations. A lot of other things have also been noted during the observations.

At six of the reference companies site interviews were performed and those included a round tour within their facilities with focus on their planning boards and meeting rooms. To be able to see their actual settings helped the researchers to gain an understanding of how the specific company worked with Visual Planning. At one of the companies a meeting was also observed, which had similarities to the stand-up meetings at the case company.

2.2.4 Testing though PDCA-cycles at the case company

Testing has been performed at the case company to investigate, evaluate and verify ideas and approaches found in the frame of reference and observed at the case companies to address the problems identified at the case company. The testing has been performed iteratively through PDCA-cycles. However, a full PDCA-cycle was not performed between every test occasion with the team, as there was a need for them to become comfortable with the new method before updating it.

The study has included one test period with three different teams, where within two teams where the tested tool for Visual Planning used at their actual meeting, while in the third team was it used at separate workshops. The live setting gave the possibility to verify and evaluate other aspects than the tested tool for Visual Planning, which was considered to be of importance as Visual Planning is much more than a tool. There have been some restrictions from the stakeholders about the timing of the report and when testing can be performed, and the test period should fit the study's schedule and the company's schedule. Team 1 consists of team members at one site, and those tests lasted for twelve weeks. Benefits of testing the tool at a single-site team was that it was possible to address pitfalls before it was tested a multi-sites, but also to address the research question of how Visual Planning can help a team to succeed.

The researchers have prepared everything that has been included in the test, e.g. give the team members access to the tool and preparation of the meeting room. If some of these ideas will be used in the future, the context will be adapted to them and therefore was there a wish to try to get as real and actual conditions as possible. During the test period was a more formal structure for observation used than the observation technics used when the team first were observed, Chapter 8. Formal observations only consider studying some decided aspects (Robson, 2011), and as the test was used

to improve some aspect, those aspect were already known. However, when introducing a new way of working were more aspects affected than what is possible to know on beforehand, therefore were also notes taken about other aspects. The researcher had a more active role in these settings, as the ones introducing the test, than during the data collection. In addition to the observations where some standard questions asked after the meeting to the participants, which they answered individually. The use of standard questions has made it easier to evaluate and compare different tests, and to get the views from the participants.

2.3 Reliability and validity

Robson (2011) discuss how researchers can create trustworthiness in a flexible design research. There are not standard ways to ensure reliability and validity within a flexible design research as there is in a fixed design using a quantitative approach (Robson, 2011).

There are four criteria that strengthen the reliability of a source according to Scott (2014), and these are: authenticity, credibility, representativeness, and meaning. Bryman and Bell (2003) also highlight some aspects that one should consider when evaluating the reliability of documents. These includes: who produced it and why, and if it is possible to identifying whether it is objective and trustworthy or not (Bryman & Bell, 2003). These evaluation criteria has been used during the study, and the reliability of the publisher has also been taken into consideration.

Bryman and Bell (2003) highly recommended that the interviews in a quantitative research should be audio taped and transcribed. The interviews at the reference companies was not recorded due to they were mostly performed walking and standing, and the interviewers wanted to keep the almost familiar atmosphere which accord during the interviews. The interviews at the case company were recorded, but not transcribed, instead have the recording been used as backup and citations. It has been consider as too time consuming and it has been prioritised to use the time on performing more interviews than on transcribing a few. To ensure the accuracy have the interviews been summarised and sent to the interviewee for approval. In this way it is also possible to get correction if the interviewers have misunderstood something, which would been possible if the data was transcribed. When data is transcribed is there a risk that the emphasis is missed or faulty represented in the text. Therefore, the researcher believe that they can ensure the trustworthiness of the empirical data, especially as one was focused on taking notes and the other to hold the interviews.

There have been a close relation to the case company during the study, as it has been an action based case study. The researchers have used some methods to stay objective during the project. These methods are: data triangulation (used different kind of methods for data collection; interviews, secondary data, observations, articles, etcetera), member checking (the interviewee's has approved a summing of the interviews), and audit trail (the researchers have kept a record of your work) (Robson, 2011). In addition have individual feedback been collected from the participants during the tests, to make sure their opinions will be caught instead of the researchers' impression of the situations.

The researchers will take an active role in simulating activities and tests which could affect the result, therefore the researchers' role in these situations have been taken into consideration during the analysis. The researchers are also considered by the test teams to be the expert within tool that was tested. This made it sometimes difficult to only observe the meetings where the software was used due to questions from the participants on how to best use the tool. However, the researchers have

during these times focused on explaining the functions of the tool when asked and to move the discussion to outside the meetings on how they best can use the tool for their purpose.

3 Frame of Reference

The Frame of Reference includes an introduction to this field of study, and what the researchers within the field have highlighted within Visual Planning, Successful teams and Multi-site teams using Visual Planning.

As products become more complex and the competition increases (Clark & Fujimoto, 1991) the development of new products has become increasingly more important to companies (Chen, et al., 2010). It has even been stated that a high-quality product development process is the most important driver for success in product development (Cooper & Kleinschmidt, 1995). Therefore all companies have a method for developing new products, since without the correct information at the right time projects can be delayed due to re-work and modifications (Zirger & Hartley, 1994).

The process of developing new products has changed a lot over the past 40 years. During the 80's the Japanese sprinted away from its competitors concerning number of product models and time to market (Womack, et al., 1991). The Japanese companies relied on a concept later termed as Lean Product Development (LPD) (Womack, et al., 1991). In the 90's many companies used the stage-gate system for project processes (Cooper & Kleinschmidt, 1993) which is often referred to as New Product Development (NPD). Both methods are still used by many companies today.

Another concept used in product development is Agile development. Its largest use is within software development, but the method has been tested in product development with success, then referred to as Agile Product Development (APD).

3.1 Organising product development

Product development within a company is often organised into a matrix organisation with one axis as projects and the other as different types of resources as seen in Figure 3-1. The resources are the functions containing the employees and projects the actual development projects occurring within the company. All projects demands different resources (functions) and have different time horizons depending on if they are within maintenance, new products or new technology (Mascitelli, 2011).

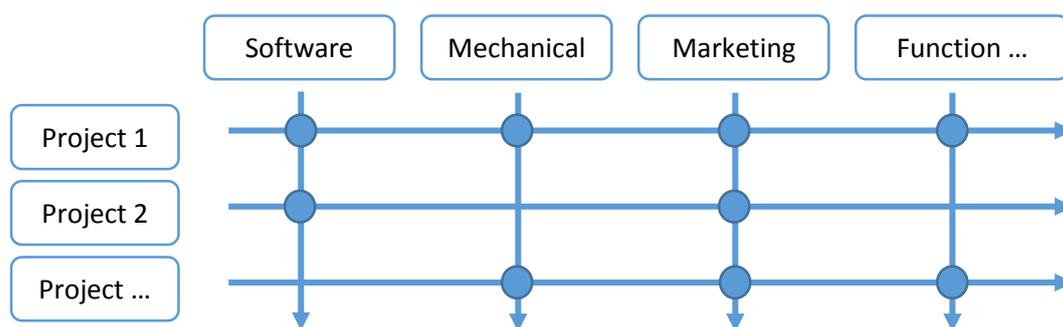


Figure 3-1 Example of matrix organisation for product development

Mascitelli (2011) argues for the importance of clear and stable priorities between projects over time, and that the employees should not be involved in more than two major or three smaller projects at the same time. The higher number of projects an employee works with the more time goes to waste and if this is not thought of before planning the plan will not work. A developer need to have time to work undisturbed to be able to focus, and when an individual tries to work on two tasks at once there will be setup and change over time when shifting focus from the first task to the second (Mascitelli,

2011). It is beneficial to dedicate two hours per day when the employees would not have any meetings or emails to respond (Mascitelli, 2011).

3.2 Lean Product Development

What LPD represents varies, León and Harris (2011) have systematically collected the research done concerning LPD from the terms creation in the 80's to 2011. One of their assessments is that a lot of the research done in the area of LPD has been focused on “what” should be done rather than “how”. A wide definition of LPD can be “the cross-functional design practices (techniques and tools) that are governed by the philosophical underpinnings of lean thinking – value, value stream, flow, pull, and perfection – and can be used (but are not limited) to maximize value and eliminate waste in product development” (Leon & Farris, 2011). Others have narrowed the definition to “application of lean principles to the PD process to eliminate wastes” (Wang, et al., 2012) while another highlights the importance of not being stuck in the techniques of LPD, but to focus on the coherent whole (Karlsson & Åhlström, 1996).

The theories behind Lean production dates back to the 50's when Toyota started building up their production system, but as previously mentioned the term was not coined until the end of the 80's by Krafcik (1988). Ever since western scientists and companies got interested in the Japanese car manufacturers the research field has exploded. Not long after the concept Lean production was defined Lean Product Development was coined (Womack, et al., 1991).

3.2.1 Important aspects of LPD

Large differences 25 years ago between the Japanese's lean and West's mass concept were leadership, teamwork, communication and simultaneous development (Womack, et al., 1991). Their descriptions as Womack, et al. (1991) understood them follow in the headlines below.

Leadership

In every project there is a leader, a *shusa*, responsible and he or she have large authorities over every employee and the project itself. Top management is not supposed to inflict on the projects specifications due to corporate needs, which can happen in Western companies.

Teamwork

In western companies it was common that members of a project are temporarily borrowed to projects, but still report to the home division (authors note: this is still common today). In LPD project members are owned by the project for the duration of the project. Their performance will be judged by the *shusa* and the *shusa* will probably control the next assignment after the project is finished. This creates another kind of urgency since failure to deliver can have consequences on the career. Also number of involved engineers in a project varied greatly from 485 in Japan to 903 and 904 for United States and Europe respectively (Clark, et al., 1987). The concluded reason for the difference was that when an engineer work within their own division their knowledge is thinner than when an engineer work in multifunctional project team.

Communication

In LPD conflicts should arise earlier rather than later. For example, in the beginning of a project, formal pledges are signed by every member to ensure that everyone performs what has been agreed upon. In the United States more vague commitments are made to what should be accomplished and conflicts

arise later in the project when there are unexpected and unsure outcomes (Clark, et al., 1987). A reason for why Japanese companies avoid late conflicts becomes clear when overviewing where in a project most people are involved. There are never more people involved in a project at Toyota or Honda than in the beginning unlike western companies that increase the amount of people involved as the project goes a long (Clark, et al., 1987). When engineers become involved later in the process there is not the same feeling of obligation as one who has been involved from the beginning.

Simultaneous development

In cross-functional project teams there are more communication between the functions which simplifies development of several areas at the same time. For example planning of production does not have to wait until the product is designed.

3.2.2 Terms from Toyota Product Development

Toyota has over the years developed several new tools for creating value oriented processes. Two of these are Obeya (or Oobeya) and Barashi.

Obeya

The translation of Obeya is “big room”, but it is often referred to as the war room. It is a large room containing several visual management tools such as pulse-status, design graphics, quality information, manpower charts, and financial status amongst other important performance indicators (Liker, 2004). From the Obeya room a complete overview of the project can be gathered and Toyota has found that the room enables fast decisions, good communications, alignment, and highlights the importance of team integration (Liker, 2004).

Barashi

A Barashi is created in the beginning of every project at Toyota. It contains information for what the project will achieve, how it will be done and any knowledge gaps present (Tanaka & Tanner, 2011). There is one for the overall project and then one for each discipline involved in the project. What separates a Barashi from usual plans created in projects is that each discipline only has a sheet of paper (A4) to fill with all the necessary information for the project. Tanaka and Turner (2011, p. 3) gives three purposes for Barashi, Table 3-1.

Table 3-1: A Barashi serves three purposes. Interpreting of Tanaka and Turner (2011, p. 3)

- A clear process for creating the Barashi which ensures that the objectives for the project are clear and there is a plan for how to reach them.
- Enhanced communication between the disciplines of the project due to that every discipline has a Barashi with targets and methods for how to reach them.
- It becomes the base for short and powerful presentations since it concludes the essence of the project.

3.2.3 Final remarks of LPD

There is quite extensive research done in the area of *what* areas of lean production can be adapted to LPD, but *how* a lean product development should be achieved is not yet defined (Leon & Farris, 2011).

3.3 New Product Development

During the 90's the concept *New Product Development* was defined and it is a result of analysing common factors of successful companies (Cooper & Kleinschmidt, 1993). Later, five areas were defined as the ones to have the largest impact for successful product development, Table 3-2.

Table 3-2: Summing of targets impacts according to Cooper and Kleinschmidt (1995, p. 377)

1. **Process:** The framework chosen for product development within a company will affect the outcome greatly.
2. **Organisation:** Example cross-functional teams versus a functional approach
3. **Strategy:** The total new product strategy that is a part of the corporate strategy.
4. **Culture:** The climate at the company, example support from co-workers.
5. **Commitment:** Especially senior managements and corporate commitment to the product development.

As seen by the list NPD is not as much a specific concept as a guideline towards what is important to succeed in projects. NPD is often structured through the stage-gate system which is a set of defined gates that includes the entire process of product development, from product idea to shipment of the finished product to customer. It therefore includes all functions involved in the development of a new product, such as R&D, marketing, production, supply chain and more. The advantage is the possibilities to parallel flows since the project does not have to step between the departments, but everyone delivers to the overall plan (Cooper & Kleinschmidt, 1993). A common overview of the stage-gate system can be seen in Figure 3-2. When a stage-gate system is used in product development, Mascitelli (2011) argue that it states “what” should be done rather than “how”, which is what is most relevant to address in planning.

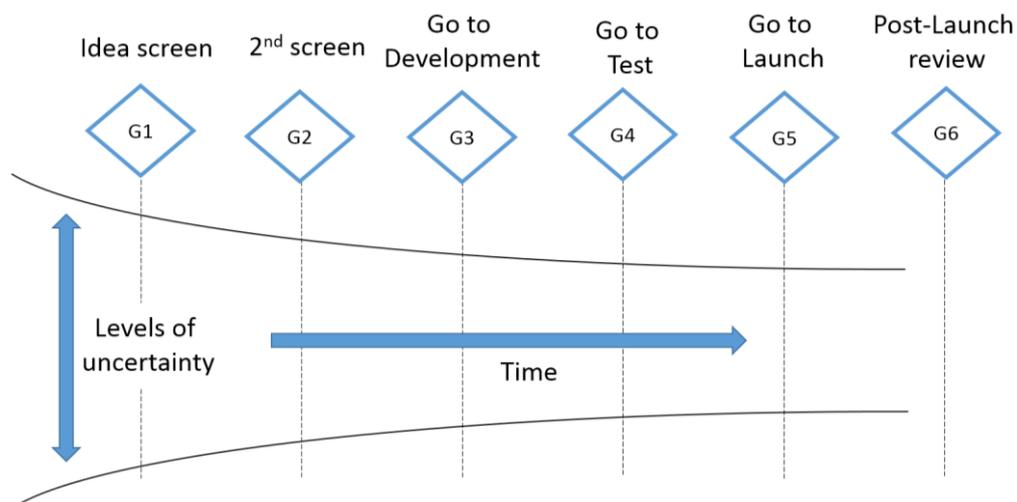


Figure 3-2: The Stage Gate process. Adaption from (Cooper, u.d.)

An alternative to working with the stage-gate system is Agile Development, described in next chapter.

3.4 Agile Development

Agile development is a method evolved within software development. The field of software development arose during the Cold war when there was races towards new technology and the projects where very large and there was a large need for structure (Gustavsson, 2013). The same

methods were continuously used when the field of software development expanded, but they were seen as too rigid by the community since projects often changed directions and plans (Williams & Cockburn, 2003). Agile software development arose as an alternative and in 2001 a group of seventeen experts in the field of software development gathered and wrote the Manifesto for Agile Software Development Table 3-3.

Table 3-3: The Manifesto for Agile Software Development (agilemanifesto.org, 2001)

We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- **Individuals and interactions** over processes and tools
- **Working software** over comprehensive documentation
- **Customer collaboration** over contract negotiation
- **Responding to change** over following a plan

That is, while there is value in the items on the right, we value the items on the left more.

The manifesto and its twelve following principles aims at finding a method that is agile enough to counter the uncertainties of a project without being so vague that it is compromising quality and necessary documentation (Fowler & Highsmith, 2001). From the method several tools and frameworks have been developed, but these have not been researched enough to know their impact on the project outcomes (Dybå & Dingsøyr, 2008). One of the least researched is Scrum, yet it is one of the most popular in the industry (Dybå & Dingsøyr, 2008).

3.4.1 Scrum

“Scrum is a management and control process that cuts through complexity to focus on building software that meet business needs” (Schwaber & Beedle, 2002, p. 2) is a definition for *what* Scrum do. All involved in projects using scrum should have an understanding of the framework, but the structure depends on a scrum master (Schwaber & Beedle, 2002). The scrum master is responsible for everyone following the rules of scrum and ensure decisions and solutions are made to issues that arise (Schwaber & Beedle, 2002).

To be more specific to *how* Scrum reach result another definition is “... a development framework in which cross-functional teams develop products or projects in an iterative, incremental manner” (Deemer, et al., 2012, p. 3). The iterative process is achieved through several sprints which are a limited periods of time where items are included from a Sprint backlog, and the Sprint backlog is in turn deduced from a Product backlog handled by the Product owner (Schwaber & Beedle, 2002). Once a sprint has started items cannot be added and also important is that the length of a sprint is never prolonged, so if items are not finished they have to be moved to another sprint (Deemer, et al., 2012). The purpose of this is to have short periods of time, a standard is two weeks, where work can continue uninterrupted from discussions concerning project content and scheduling (Deemer, et al., 2012).

What is special with scrum teams is that the team has complete authority for how to reach goals set in a sprint and what a sprint will include from the Product backlog is decided by the team and the

Scrum master so that the team has ownership of what they should achieve (Schwaber & Beedle, 2002). A regular team size is approximately seven people with varying knowledge (Schwaber & Beedle, 2002).

Meetings

A scrum team has three recurring standard meetings: Daily scrum, Sprint planning meeting, and Sprint review meeting (Schwaber & Beedle, 2002). The Daily scrum is a 15 minute meeting held every morning to review the progress of the current sprint and all team members have to attend (Schwaber & Beedle, 2002). A sprint planning meeting is actually two meetings, the first is a meeting between the Product owner, the team and the Scrum master to know what functionality should be created through the next sprint (Schwaber & Beedle, 2002). At the second meeting only the team is present and the members specify how the specified functionality should be reached and tasks to the Sprint log is created from the Product Backlog (Schwaber & Beedle, 2002). The third meeting, the Sprint review meeting, is held at the conclusion of a sprint and includes both the team and management and that which have been developed during the sprint is either built upon, scavenged or removed (Schwaber & Beedle, 2002).

The Scrum board

It is common to use a Scrum board at the Daily scrum meetings and it to consist of tasks written on sticky notes put on a whiteboard. The sticky notes are arranged within different columns and usual columns to use are: To Do, Work in Progress and Done, Figure 3-3. (Deemer, et al., 2012)

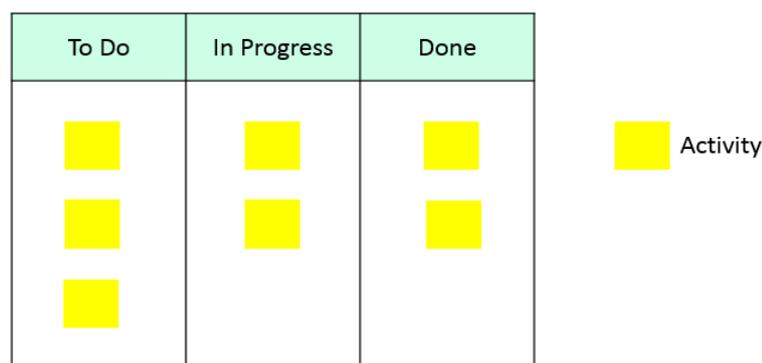


Figure 3-3: A schematic figure of a typical Scrum Board (Deemer, et al., 2012, p. 10)

3.4.2 Agile Product Development

Even though agile development has mostly been developed towards software development the manifesto and most of the principles are universally written and agile development has increased in product development. There are many areas of development where teams need to reach goals that are being challenged by uncertainties, new requirements and shorter delivery times amongst others which agile development is suited for (Jackson, 2012). One of the largest purposes of agile development is for project management to remove whatever is hindering developers in their work and included in that is to reduce top management and leave the ownership of the project to the team (Jackson, 2012).

As mentioned previously there is not enough research done for agile software development and there is even less done concerning agile product development, of how the method can be adapted to suit projects that involves other areas than software.

3.5 Visual Management within Product Development

Visualisation of different kinds are commonly used in industry today, both in production environments and within product development and the research is expanding (Leon & Farris, 2011). Many highlights the importance of visualisation within product development, but the terminology varies: Visual Control (Liker, 2004); (Parry & Turner, 2006), Visual Workflow Management (Mascitelli, 2011) and Visual Management (Lindlöf, 2014). Liker (2004), Parry and Turner (2006), and Mascitelli (2011) connect visualisation to Lean, and Liker (2004) ch. 13.2 describes visual control as “any communication device used in the work environment that tells us at a glance how work should be done and whether it is deviating from the standard”. Lindlöf (2014, p. 30) argues that “visualization supports human cognitive functions”, and has been well researched.

Visualisation in production and product development is often used to get an overview of the situation. Parry and Turner (2006) believe that visual control can help companies to high performance and Mascitelli (2011) argue that a company should start their Lean implementation by adopting Visual Workflow Management. Visual Workflow Management will ensure fast and visible improvements which is crucial to create long-term and successful changes within an organisation. According to Söderberg and Alfredson (2011), several companies start their Lean journey by implementing “Visual Planning”. By the use of visualisation the problems will be lifted to the surface, i.e. visible, which make them easier to address before it is too late (Liker, 2004). Lindlöf (2014, p. 24) highlights task communication within product visualisation and says it is rather unexplored area and relates it to “the planning and execution of tasks”.

Holmdahl (2010) includes a resource planning board within Visual Planning and Lindlöf (2014) calls this a Pulse board, which will be the term used in this report. According to Kaya, et al (2014b) the pulse methodology is similar to Visual Planning and Scrum, and will be covered in Chapter 3.5.2 *Pulse Methodology*.

3.5.1 Visual Planning

The research concerning visual planning is limited (Lindlöf & Söderberg, 2011) and therefore the name, definitions and description of the methods on the matter varies (Lindlöf, 2014). For example, what Lindlöf (2014) and Söderberg and Alfredson (2011) describes as Visual Planning can be included in Mascitelli’s (2011) term Visual Workflow Management. Also the consultant company JMAC have developed the term Knowledge Innovation/Visible Planning (KIVP) (JMAC, 2015), but it is very similar to previous descriptions of Visual Planning. Lindlöf has written a doctoral dissertation and has evolved several definitions of Visual Planning through his work:

“Visual planning is a simple method where activities and deliverables are outlined and illustrated on a physical planning board and discussed at frequent meetings.” (Lindlöf & Söderberg, 2011, p. 2)

“Visual planning is when development teams use frequent meetings and physical representations of tasks in order to manage deliverables and tasks throughout the execution of a project.” (Lindlöf & Trygg, 2012, p. 4).

“One method for development teams to handle this task coordination is to visualize tasks and deliverables to enhance their communication and coordination within the team.”

(Lindlöf, 2014, p. 26)

These definitions of Visual Planning indicate that research within the field have developed to include more aspects, and emphasise the support for the team.

Purpose and use of Visual Planning

Mascitelli (2011) considers the main purpose of Visual Planning to be *interactivity*, while Holmdahl (2010) mentions some traditional purposes such as creating expectations, coordination and localising deviation along with others such as organisational learning and allocation of resources. Mascitelli (2011) cites general Dwight D. Eisenhower “Plans are nothing, but planning is everything”, and even if Mascitelli does not concur completely to the first half of the phrase he does agree with the second, planning a project is vital for a project’s success. Swan (2015) thinks the planning is an activity that should be performed within the team, while the plan shows the result of the planning. Visual planning is a dynamic management tool that continuously track and updates the plan (Swan, 2015).

Söderberg and Alfredson (2011) argue that Visual Planning support an organisation’s capability to process information and that it will help product development teams in their daily work to handle increasingly more complex products. Lindlöf and Söderberg (2011) highlight that there are benefits with Visual Planning within communication and coordination. Lindlöf and Trygg (2012) further points to Visual Planning’s ability to enable improved internal communication; both participative and reflective, but even that the objectives of the projects and activities gain clarity among the team members. The whole team will gain increased communication efficiency by short and frequent meetings and access to real time information, the managers and the leaders will mostly see the benefits of coordination. However, for visual planning to be useful it is important that there is a need for coordination between the team members that their work is related (Lindlöf & Söderberg, 2011). Lindlöf and Söderberg (2011) stress the importance of seeing Visual Planning as a complement to previous working methods, not a replacement. Also Mascitelli (2011) highlights the importance of the team instead of the team leader to lead the meetings and to decide what to do. In Table 3-4 documented benefits of Visual Planning are presented.

Table 3-4: Experienced benefits Visual Planning can led to (Holmdahl, 2010, pp. 136-137 and p. 140)

- Efficient resource utilisation
- Less delays
- Better control though: increased participation, increased understanding and simplified problem solving
- Resource balancing
- Increased flexibility
- Knowledge dissemination
- Reduced work, due to limiting the need of double work
- Better control/managing of the organisation

Söderberg and Alfredson (2011) believe Visual Planning consists of two components: the boards and the meetings, and consider them to be equally important. Lindlöf and Trygg (2012) adds that these should be implemented together. Mascitelli (2011) also emphasise that boards and meetings should

be used together. In Figure 3-4 a version of a typical Visual Planning board is presented and within this study it will be referred to as a VP-board and the meetings will be referred to as VP-meetings.

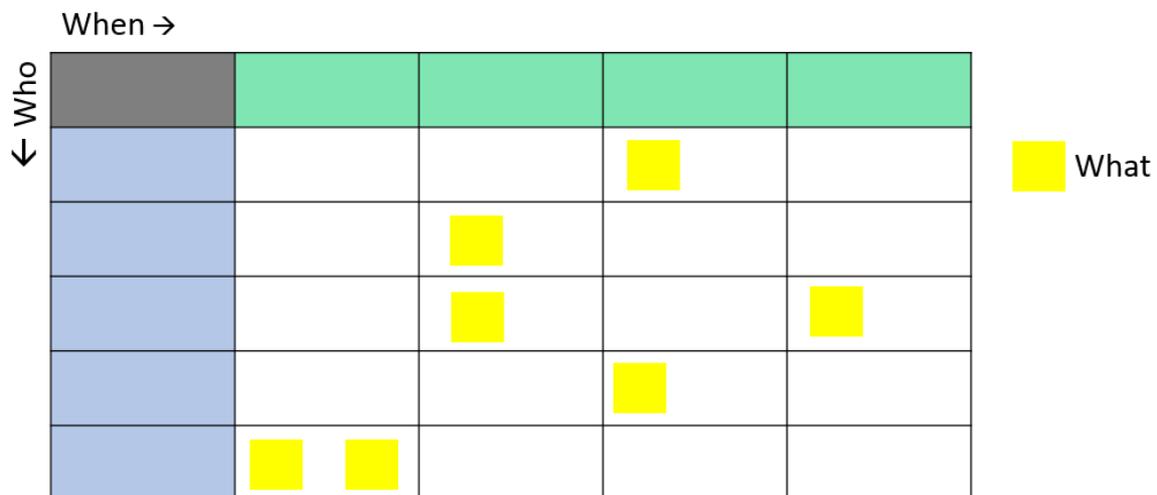


Figure 3-4: A schematic sketch of a VP-board based on Holmdahl (2010, p. 137)

Holmdahl (2010) believes that for best effect of Visual Planning it should be used from the management group and down through the entire the organisation. According to Lindlöf and Söderberg (2011) it is common that VP-boards consist of three time horizons: short-term (days), mid-term (weeks) and long-term (months/years). The horizontal lanes in the mid-term board can show the different functions involved in the project, while the functions have their individual short-term boards (Holmdahl, 2010). The short-term boards are usually consists of the individual team members at the horizontal lanes (Holmdahl, 2010). According to Swan (2015) it is the connection between the mid-term VP-board and the short-term VP-board that usually is tricky and it is common that employees feel resistance to plan their work on a daily basis. He therefore recommends the use of two boards: a long-term VP-board and one mid-term VP-board.

However, before a team can have a VP-board and VP-meetings they have to create the plans and consider the risks within the project.

The creation of Visual Planning

Mascitelli (2011) discuss the creation of a VP and base it on project planning and risk-mitigation in the start of a project. The base should focus on *how* a project should be accomplished and not *what* as Mascitelli (2011) believes the stage-gate system do. Therefore planning and risk-mitigation should be performed by the project team since those have the knowledge for how to reach the goal, the *what* (Mascitelli, 2011). Also if the team creates the plan there is a greater feeling of ownership from them and it is more likely that the project will finish on time (Mascitelli, 2011). It is important that teams understand the basics of project management, and to remember that it is impossible to create the perfect plan instead one should focus on getting a good starting point (Mascitelli, 2011). Mascitelli (2011) suggests that one should start with a blank paper and that the team members should write their deliveries within the project at a sticky note. He also recommend the team members to start with the final deliverables and to work their way backwards and to keep the detail as low.

According to Mascitelli (2011, p. 152) the outputs from the project planning and risk-mitigation event should be: High-level project master schedule, estimated product launch date, resource estimates and

project budget, prioritized list of project risks and actions required to close the event. In this example the risks are prioritised by what probability they will occur and what the impact would be. The master schedule will work as the foundation for a three month VP-board (Mascitelli, 2011).

As previously stated Holmdahl (2010) believes that the project team performing the work should perform the visual planning, but it should be based on the milestones that are set by people outside the project team. Holmdahl (2010) emphasis that the one performing the work should do the planning, due to commitment and knowledge dissemination. . Swan (2015) on the other hand argues that there first has to be a common understanding of what should be done in a project and to identify possible knowledge gaps, by doing a “Barashi”, a visual target breakdown structure to clarify the project. The long-term plan is then based on the Barashi and represents the agreed upon commitments and the overall deliverables within the team (Swan, 2015). The Barashi and long-term plan can best be created at a common workshop for the whole team (Swan, 2015). The Barashi and the long-term and mid-term plans should help the individuals to see dependencies within the team and with other teams and to give an understanding of what should be done (Swan, 2015). The quality of the resulting plan is dependent on the knowledge and capability of the team members. Swan (2015) argues that a team cannot blame the tool if the plan is of low quality, since the tool is only a tool and it only reflects the ability of the users. However the tool will help in exposing such issues so that countermeasures can be taken directly, rather than hiding them for later.

The VP-board

Due to the lack of a homogenous description for the method Visual Planning, the boards also varies. However, there is a consensus that they are physical, digital visual planning board will be discussed in Chapter 3.5.3 *The use of software within Visual Planning*. Mascitelli (2011) recommend the use of a visual project board which include planned and unplanned work, a two-week action plan, a project timeline, problem solving and a parking lot. The consultant firm JMAC divide the board into two: qualitative (Barashi) and quantitative (JMAC, 2015). The qualitative include goals and requirements and the quantitative include three matrixes with time horizon on the x-label and resources on the y-label. The three time horizons are long-term, monthly, and weekly and the resources are required functions or persons. Holmdahl (2010) also states that VP-boards can be used for other areas than projects.

Lindlöf and Söderberg (2011) have performed a study at four case companies and the VP-boards at these companies varied slightly but where all variants of a short-term board, a mid-term board and a long-term board, with the resolutions days, weeks, month or even years, respectively. The short-term board have similarities to the two-week action plan described by Mascitelli (2011). A rule of thumb is that every delivery on the long-term plan should have at least one but probably more than one corresponding note on the mid-term board (Swan, 2015). Other suggested additions to the board is an inbox for possibility to add discovered crucial problems that then can be assigned to someone at a later meeting (Lindlöf and Söderberg, 2011).

Commonly sticky-notes are used for the activities on the VP-board (Holmdahl, 2010); (Lindlöf & Söderberg, 2011); (Mascitelli, 2011). Lindlöf and Söderberg (2011) highlights that it is the team members that write their own sticky noes on what they should do. The sticky-notes can be colour coded in different ways. Lindlöf and Trygg (2012) believe the team should be allowed to affect their layout of the board but to use standard notes for: activities, deliverables and critical issues. The companies studied by Lindlöf and Söderberg (2011) used different colours for deliverables, activities,

problems and absence. Holmdahl (2010) use three different colours for: activities, deliveries and milestones. Swan (2015) commented on the benefits of highlighting the “critical notes” to mark if something is especially critical to complete in time, e.g. by a red frame. However, Mascitelli (2011) use different colours corresponding to its priority One could also use input-notes, i.e. if one deliverable should be performed by another team the team waiting for the delivery have an input-note (Swan, 2015). A typical sticky note includes text, estimated time, real time and a red mark if it is delayed, Figure 3-5 (Holmdahl, 2010).

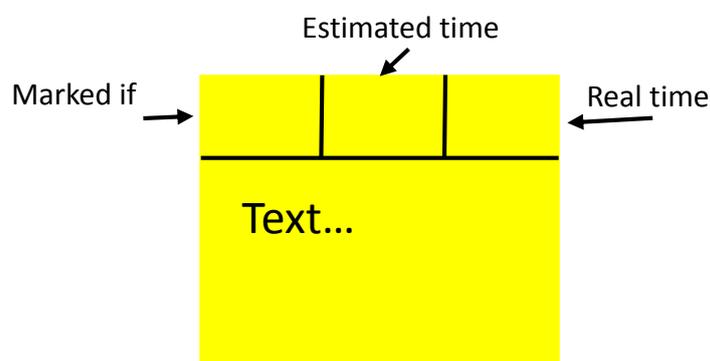


Figure 3-5: A typical post-it note according to Holmdahl (2010, p. 138)

Lindlöf and Trygg (2012) states that the VP-board help teams to see current status of a project, and to work with a common truth instead of decisions based on different beliefs within the project. However, drawbacks with the VP-board are difficulties to track and link activities on the VP-board and it need work to track the data related to the progress of the project (Lindlöf & Söderberg, 2011). Söderberg and Alfredson (2011) also highlights the lack of connection between the notes, and say that visual planning facilitates communication but not correlations between the notes when a note is moved.

The meetings

The meetings at Lindlöf’s and Söderberg’s (2011) case companies were short and hold standing-up which was seen as essential. These meetings primary focus on the short-term VP-board (authors’ note). The meetings where commonly 15 minutes and held frequently. However, how frequent varied from every day to once a week depending on the needs of communication for each specific group. Most common were two meetings per week. The meetings usually started with the team manager highlighting some common deliverables and/or issues, and then every team member had a time slot each to go through the status of their respective lane and to address possible problems. Due to the short time available at the meeting, there is no time for discussions. If there is a need another meeting should be booked with concerned members. It is also possible to use an hourglass to keep track of each individuals time. Lindlöf and Söderberg (2011) also highlighted the position of the VP-board and that a board close to everyone’s workspace encourage interaction. (Lindlöf & Söderberg, 2011)

The idea for stand-up meetings in product development come from the shift-change meetings within production, where issues and likewise are addressed (Mascitelli, 2007). Stand-up meetings should be brief to create a sense of urgency (Mascitelli, 2011). Benefits with a stand-up meeting is that no one gets comfortable and starts doing other things such as checking phones and emails, the team focus on the VP-board (Mascitelli, 2007). Mascitelli (2007) mentions some other benefits as well, which are summarised in Table 3-5.

Table 3-5: (Mascitelli, 2007, Ch. 5.2, figure 5.8)

- Creates a shared language among team members
- Allows for real-time reallocation of resources
- Encourages focus on value-creating activities
- Establishes a clear, prioritized work for each day
- Provides a mechanism for cultural change
- Builds team identity and emotional commitment

Mascitelli (2007) recommends morning meetings since if the meeting is during the afternoon the task will be forgotten to the next day. He also highlights that whole teams should attend, preferable in person, but otherwise by phone or another member has responsibility re-cap the progress. According to Mascitelli (2007) people appreciate routines, and he recommend that there should be a consensus for the meeting's structure. Mascitelli (2011) recommend 15 minute meetings and that the frequency of the meetings should be adapted to the current phase's intensity, it can vary from twice a day to monthly, but most common is three times a week. The team members must have enough time for new information to occur between the meetings, but too few meetings will increase the risk of misunderstandings and incorrect assumptions (Mascitelli, 2011). Swan (2015) recommend to have meetings twice as often as the finest detailed level at the short-term VP-board, e.g. if the plan show weeks, there should be a meeting twice a week. One risk that might occur if the meetings are hold too seldom is that decisions will be taken in a parallel process (Swan, 2015).

Mascitelli (2011) emphasis that focus should be on the team and not the team leader, and encourage rotating facilitator for the meetings. However, Mascitelli (2007) believes the facilitator should ask every team member three common questions during the meeting, Table 3-6.

Table 3-6: The meeting facilitator should ask each attendee to respond to three basic questions according to Mascitelli (2007, figure 5.2)

- What work did you complete since the last meeting?
- What work will you accomplish before the next meeting?
- What do you need from other attendees to achieve your goals?

Lindlöf and Söderberg (2011) also highlights that the VP-meeting enables early problem-solving through the frequent meetings in combination with the visualisation of activities. Lastly a VP-board is continuously updated and show real-time information so it is possible to follow team members' workload (Söderberg & Alfredson, 2012) and work proactive (Lindlöf & Trygg, 2012).

3.5.2 Pulse Methodology

Pulse methodology has the same kind of logic as visual planning, but focus on the project portfolio level (Lindlöf, 2014). The Pulse methodology was developed by Scania in 2003, and is based on lean with focus on deviations and used by managers to synchronise the company (Kaya, et al., 2014a). Just as Visual Planning, Pulse consist of two parts: the pulse-board and the frequent short pulse-meetings (Kaya, et al., 2014a). Kaya, et al. (2014a) say that each company included in their study used a slightly different pulse-board, but that the basics were the same. The pulse-board consist of a matrix where the status of several projects is shown across several functions, i.e. the status is shown in the intersection of the current project and function (Lindlöf, 2014). The status is shown through coloured magnets, and according to Kaya, et al. (2014a) there are three to four colours used, and an example is shown in Figure 3-6.

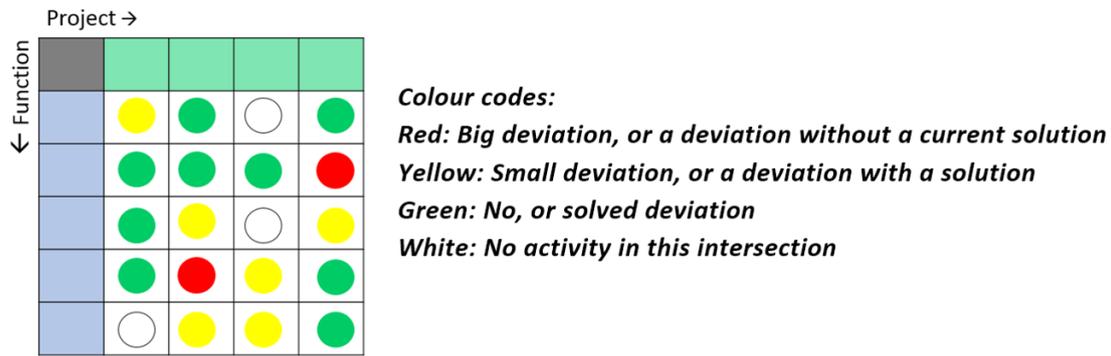


Figure 3-6: A pulse board with short explanations of colours, Projects and function could be displayed vice versa, or include products or/and departments instead. (Based on Kaya et al, 2014a, p. 276)

Mascitelli (2007) also discuss the pulse methodology but names it: The “stoplight” status chart, and focus on three activities: cost, schedule and performance. He believes it facilitates clear communication of the status for each activity within a project, and when an activity is green there is nothing of need to be discussed (Mascitelli, 2007). Lindlöf (2014) believe the pulse methodology help managers in functions and projects to get an overview of their activities.

3.5.3 The use of software within Visual Planning

Principle 7 within the Toyota Way states: Use visual control so no problems are hidden (Liker, 2004), and Swan (2015) believes most IT-tools will risk losing the advantages that a physical version has; a dynamic management tool to create a common view and commitment. However, Liker (2004) does not imply one should avoid information technology, but it should support true visual control. Lindlöf and Trygg (2012) argue software limits the availability of the information, and that the team members need to have knowledge and access to the software. Lindlöf and Söderberg (2011) see a risk less team communication when a software is used. However, Mascitelli (2007) have experienced some successful examples of IT-tools used for visual planning and believes it can be used in a similar way as a physical VP-board during meetings. But Mascitelli (2011) highlight that no virtual project board can outdate the powerful face-to-face meeting.

Swan (2015) believes one common mistake people do is to just copy the physical VP-board into the virtual environment, in this way will the drawbacks of the VP-board be kept and some of the possible benefits of having the VP-board in an IT- environment will be lost. He also thinks it is too easy to just focus on the technical aspects as “which colours and notes to use”, and highlight that the goal with visual planning is to change the behaviour of people. He believes the challenge with visual planning is to change the culture within the company, ant not the technical aspects. (Swan, 2015). On the other hand, if the wanted culture and behaviour has already been achieved, IT tools will also work well.

More about visual planning and software in teams located at different locations will be described in chapter 3.6, and some software used for Visual Management within product development will be described in chapter 4.

3.6 Successful teams

According to Katzenbach and Smith (2006) most people sees the benefits of teams within an organisation. They believe that teams should be used when there are requirements for real-time combination of multiple skills, experiences and judgments. To reach high performance it is crucial to

understand the purpose of what should be achieved and to use clear, compelling and measurable outcome-based performance goals in favour of activity-based goals. Activity-based goals focus more on the activities that should be done than the goal itself. (Katzenbach & Smith, 2006)

3.6.1 What is a team?

Katzenbach and Smith (2006) note that people have very different ideas about what a team and a group is. Shani et al (2009) discuss formal and informal groups and different types and variants of teams. A formal group is a formal part of the organisation, while an informal group are created by the individuals themselves (Shani, et al., 2009), and Shani et al (2009, p. 290) defines a group as.

“A set of three and more individuals that can identify itself and be identified by others in the organization as a group.”

Shani et al (2009) believe effective team problem solving requires both effective problem-solving and interpersonal skills, the later refers to careful listening, supporting and encouraging of other members. Shani et al (2009) argue that effective team problem solving contributes to a team performing better than the individuals. Shani et al (2009) discuss different types and variants of teams and team problem solving and mention for instance project teams, management teams and cross-functional teams. The study will use the definition by Shani et al (2009, p. 502):

“Three or more individuals with complementary skills who are committed to a common purpose or set of performance goals.”

3.6.2 Factors affecting group and team performance

Katzenbach and Smith (2006) believe there are “the six team basics” that are vital for team performance, see Table 3-7. They also mention openness and communication to be important, but do not think they are as important as those six.

Table 3-7: The six team basics according to Katzenbach and Smith (2006, p. XVII)

1. Small number of people
2. Complementary skills
3. Common purpose
4. Common set of specific performance goals
5. Commonly agreed upon working approach
6. Mutually accountability for the team’s performance

However, there is a resistance to moving away from the individual roles and to take responsibility for others as a team (number 6) (Katzenbach & Smith, 2006). It is possible for team members to focus on their individual responsibilities, their individual tasks that relates to their respective competencies but those teams will not reach the same high level of performance according to Katzenbach and Smith (2006). Katzenbach and Smith (2006) highlights that the team (or/and the organisation) continuously need to choose how teams should work; either focus on mutual accountability or individual performances, to make expectations and roles clear. If the focus is on individual performance, the members want to know to a greater extent their individual roles, tasks and responsibilities and to understand how their individual performance will be evaluated. This way of working is especially common higher up in organisations where there are possibilities to delegate work to others. (Katzenbach & Smith, 2006).

Shani et al (2009) also highlight the importance of a common view of the norms and roles, and say by knowing they will evolve spontaneously one can influence and shape the development of a group or a team. They also discuss team effectiveness and state that it is “the ability to achieve goals” (2009, p. 14) and believe team skills need education and practice. Pierce, et al. (2001) argue that when employees are given the chance to control their goal they will take more personal responsibility for reaching it.

Shani et al (2009) believes there are six factors which affect the development and performance of a group: context, purpose, composition and diversity, structure, processes and leadership, see Figure 3-7.

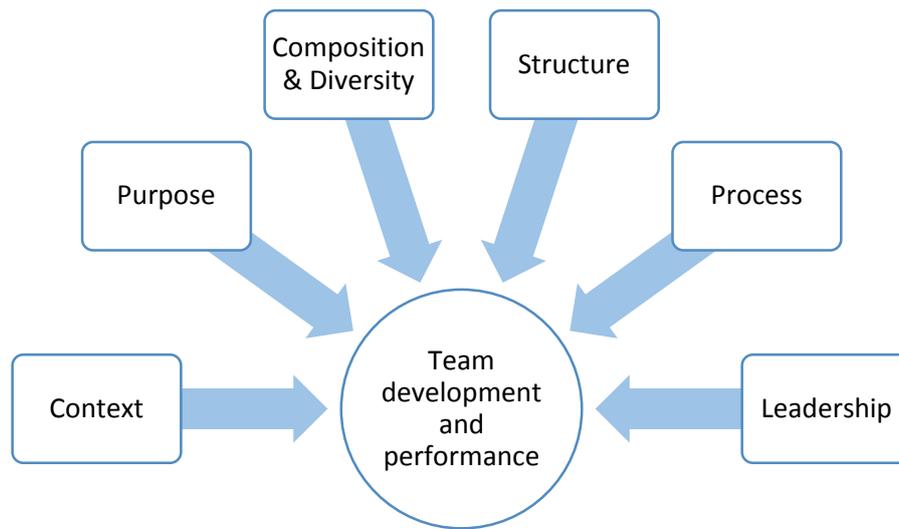


Figure 3-7: Factors affecting team development and performance adopted from Shani et al (2009, p. 331)

Context

The environment and culture that the group works within is included in the context. Schein (2010, p. 18) defines the culture of a group as: “... a pattern of shared basic assumptions learned by a group ... taught to new members as the correct way to perceive, think, and feel in the relation to those problems.” Shani et al (2009) also includes organisational characteristics which includes management philosophy and practice, decision-making processes and control systems.

Purpose

The importance of a clear purpose and defined goals are highlighted by Katzenbach and Smith (2006) and Shani et al (2009) and the latter believe goals stimulate and motivate action. Task and project characteristics are other aspects that influence the group’s performance (Shani et al, 2009).

Composition and diversity

Composition and diversity refers to the characteristics of the individuals within the unit, and includes members’ attributes (knowledge, beliefs, personality, learning style...), demographics characteristics (age, sex...) and needs (belonging, achievement, power...). (Shani et al, 2009)

Structure

The structure relates to the unit’s size, its norms and informal roles that the members likely take during the course of a project. Norms are defined as “... expectations shared by group members on how they ought to behave under a given set of circumstances” (Shani et al, 2009, p. 334). The

individuals within a team can among other roles take on a task or relationship role, where the prior focus on the actual work and the latter on the social relationship in the team. Work design is also included within the structure, and focus have commonly been on the actual work not on the processes and the teams, which will affect the work performed by the team members. (Shani et al, 2009)

Processes

There are several processes within a group that affect its performance: formation, decision making, problem solving, socialisation and communication processes. The communication process is affected by motivation and the perception of the members. The way the group communicate also affect its performance, e.g. communication through the leader or to every member. Inadequate communication media can hinder the efficiency of the communication (Shani et al, 2009)

Leadership

Katzenbach and Smith (2006) and Shani et al (2009) highlight the importance of the leader, however the prior argues that the leader seldom is the main reason for team success but play an important role if the team will evolve to a high performance team. But both sources think the leader is most crucial in the early stages when the team is in the beginning of its journey.

Katzenbach and Smith (2006) differentiate between the leadership role needed for a group and a team. In a group the leader have a more classic managing role, while a team leader need to make room for the team, i.e. not a top down approach. It is vital that the team leader believe in the team; its purpose and its members for the team to succeed (Katzenbach & Smith, 2006). Katzenbach and Smith (2006) list six aspect needed for a good team leadership, Table 3-8.

Table 3-8: Six aspects for good team leadership (Katzenbach & Smith, 2006, pp. 139-144)

1. Keep the purpose, goals, and approach relevant and meaningful
2. Build commitment and confidence
3. Strengthen the mix and the level of skills
4. Manage relationships with outsiders, including removing obstacles
5. Create opportunities for others
6. Do real work

One common pitfall for both groups and team leaders is that they mainly use their favourite leadership style, but every situation and member are unique and require different approaches (Katzenbach & Smith, 2006).

3.6.3 Groups and teams at multi-sites

The term “virtual team” is used to describe members of a group or a team that works closely together without being in the same physical location (Townsend, et al., 1998; Duarte & Snyder, 2001; Powell, et al., 2004; Hertel, et al., 2005; Katzenbach & Smith, 2006; Malhotra, et al., 2007; Shani, et al., 2009; West, 2012). A virtual team could also be spread out in time, i.e. different time zones (West, 2012). This report will use the same definition of virtual team that Townsend et al (1998, p. 18) do, but it will be termed multi-site team instead:

“Virtual teams are groups of geographically and/or organizationally dispersed coworkers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task.”

A team that are spread out within a building have some similarities with a virtual team (West, 2012). According to Hertel et al (2005) it is unusual that the whole virtual team is spread out at different location, in most virtual teams some of the members have the opportunity to have face-to-face communication with each other. Also, communication media is used by team that are located together, and is not exclusively for virtual teams (Hertel et al, 2005). Therefore, some researchers instead talk about the “virtuality” of a team (Hertel et al, 2005). High “virtuality” of a team led to both advantages and disadvantages at an individual level, an organisational level and a societal level Table 3-9 (Hertel et al, 2005).

Table 3-9: Potential Pros and Cons with high “virtuality” of teams, an own summary from Hertel et al (2005, pp. 71-72)

Levels	Pros	Cons
<i>Individual</i>	<ul style="list-style-type: none"> - Higher flexibility - Time control 	<ul style="list-style-type: none"> - Feeling of isolation - Increased risk of misunderstandings
<i>Organisational</i>	<ul style="list-style-type: none"> - Staffed based on experience rather than on local availability - Work “around the clock” 	<ul style="list-style-type: none"> - Difficult to supervise team members - Cost for appropriate technology
<i>Societal</i>	<ul style="list-style-type: none"> - Help to develop regions with low infrastructure - Help to integrate people with low mobility 	<ul style="list-style-type: none"> - Risk of increased isolation due to a technical work environment

Some characteristics are highlighted for virtual teams: they collaborate and coordinate their job with the help of electronic means and communication electronics (Townsend et al, 1998; Hertel et al, 2005; (Malhotra, et al., 2007). According to West (2012) the way of working using virtual teams is quite new which also is the case for the technology used to facilitate virtual teams. However, Hertel et al (2005) argue that work distributed over different locations is not a new thing but it has become much easier, faster and efficient with the development of electronic information and communication media.

How to develop group and team performance as a virtual team

Hertel et al (2005) describes key activities to succeed with multi-site teams and base them on the lifecycle of the team; from formation to the separation of the team, as they argues the management challenges and tasks differ between the stages.

The first phase (1) is *preparation* and includes the formation of the team; which should be involved, level of virtuality, design of the task (types and interdependence) and use of technology. High task interdependence in the beginning can facilitate the team members’ feelings of cohesiveness. This stage is generally based on strategically decisions as mergers, levels of flexibility and closeness to the market. (Hertel et al, 2005)

The second phase (2) is the *launch* and Hertel et al (2005) are supported by many researchers when they recommend that all members of the virtual team should met face-to-face at a “kick-off” (Hertel et al, 2005).

One of those that agrees are Duarte and Snyder (2001), they believe that no technology can replace interaction and mutual understanding that can be developed when people met face-to-face. Duarte and Snyder (2001) argue that this “kick-off” at least should include: an introduction and overview of the team’s task, development of guidelines (norms) for the team, plans for the use of technologies

and communication, and team building. The team building activities can be both informal as dinner party both also discussion of previous project experience, it is important that the team members feel them relevant and not as something they “just have to do”. Another critical factor for the team’s success is how the team members communicate with each other and with stakeholder, and this need to be established within the team. The kick-off will help the team to get a shared understanding of their task and roles clarify expectations of behaviour. (Duarte & Snyder, 2001)

The third phase (3) relates to performance management as the team climate build within phase two needs to be maintained (Hertel, et al., 2005). The four critical aspects within this phase are leadership, communication within the virtual team, the motivation of the virtual team members and knowledge management (Hertel et al, 2005). Katzenbach and Smith (2006) believe that the role of the leader in a virtual team is more important and complex than usual as the leader need to both adapt his or her style to the members as over physical distance. It is difficult to use direct control when the members are not at the same physical location as the leader, and Hertel et al (2005, p. 80) describes three different approaches. These approaches are electronic monitoring (related to direct leadership), management by objectives (delegating leadership) and self-managing teams (quite autonomous teamwork) (Hertel et al, 2005). If a project involves multiple sites with several team members at each site, one common approach is to have autonomous sub-teams using their own Visual planning boards (Swan, 2015). The sub-teams have local team leaders that report to the project team leader (delegated leadership) using a common Visual plan that includes deliveries and handovers between the sub-teams (Swan, 2015).

Communication in virtual teams are dominated by electronic media, and compared to face-to-face communication is it limited, for instance it is hard to “read” the mood in an email and the risk of misunderstandings increase. Hertel et al (2005) also thinks there should be a good match between the communication media and its content. To increase the feeling of belongingness and trust should non-job-related communication be facilitated, and studied has shown that the productiveness increase in teams that discuss more personal related things. Motivation and trust, team identification and satisfaction is individual and different members might feel differently, and need therefor be addressed according to this. Finally, knowledge management within a virtual team relates both to the team’s common experience and the technology needed to support equality in information. (Hertel et al, 2005)

The fourth phase (4) is training and team development which includes training of the virtual team to facilitate their team development, which could include training in electronic medias. The final phase is disbanding and re-integration, which often are neglected but according to Hertel et al (2005) it is important and includes acknowledge achievements. (Hertel et al, 2005)

Success factors for Virtual teams

Hertel et al (2005, pp. 88-89) and Duarte and Snyder (2001) discuss some aspect that they believe are important for the success of a virtual team. Table 3-10 and Table 3-11 highlights aspects that have not already been covered.

Table 3-10: Success factors for virtual teams according to Hertel et al (2005, pp. 88-89)

- Clarified goals and team roles, to avoid causing conflicts with work tasks
- Careful implementation of efficient communication and collaboration processes to prevent misunderstandings and conflict escalation due to virtual communication

- Continuous support of team awareness and performance feedback of the individual team members working situation
- Create experiences of interdependence to compensate for the feeling of disconnectedness within the team

Table 3-11: Aspects that affect the success of a virtual teams according to Duarte and Snyder (2011, table: "Points to Remember" and table "Seven factors affect the probability of a virtual team's success")

- Organisational culture
- Leadership support of virtual teams
- There is no ideal set of technologies for all teams
- A virtual team needs to have a clear strategy for matching technology to the task
- A great deal of social presence and information richness is not always desirable
- Bandwidth, cost, and compatibility issues can affect a team's performance

3.7 Multi-site teams using Visual Planning

Most of the research done concerning Visual Planning have the scope of product development at one site. There are less knowledge documented about how to use Visual Planning in multi-site projects. Lindlöf (2014) identify this as an area in need of more future research, and that many believe Visual Planning need a single-site team to work. According to Lindlöf (2014) rich communication is needed to gain the benefits of Visual Planning, and a single-site team can be seen as a prerequisite. However, Lindlöf (2014) also assumes that Visual Planning can support a multi-site team, if further effort is taken to adapt it to its context. He presumes that the standards of Visual Planning could be beneficial for communication between sites to limit misunderstandings within communication due to culture and language differences. Lindlöf (2014), Söderberg and Alfredson (2012) and Mascitelli (2011) highlights the importance of face-to-face communication at frequent meetings.

Törlind and Larsson (2002) highlights the importance of informal communication in multi-site collaboration to increase the common understanding, and adds that video conferencing is a strong tool. Their study also shown that it is the continuous communication that is of importance, not the actual tool supporting it. They experimented with awareness cameras (cameras with a continuously open video link between the offices) which could help to reduce misunderstandings due to different locations. (Törlind & Larsson, 2002)

Mascitelli (2007) discuss different types of meetings should use an appropriate communication technology, and argue that coordination meetings (as the VP-meetings described in chapter 3.4.1.3) should use phone equipment when face-to-face communication is not possible. However, if the purpose of the meeting is collaboration should vide conference equipment be used (Mascitelli, 2007). Hertel et al (2005) also argue the use of equipment should be based on the need of collaboration.

Swan (2015) also believe IT tools can be helpful when the development group is scattered at different locations. However, he highlights that Visual Planning should drive a change of behaviour to autonomous employees, and once you have reached the desired behaviour, an advanced IT-system won't be needed. Instead MS Excel of MS PowerPoint could work just fine. He believes it is too common that the introduction of software lead to focus on the implementation of the tool, and not the change in behaviour. He believes it is possible to use a master VP-board (whiteboard) at the main site, and to mirror the long-term board to the other site, possibly using MS Excel. Swan (2015) see the

long-term board as an agreement and it should be fairly stable over time. Therefore it is possible to mirror it and this system has worked well in many companies. However, when creating the long-term board it is valuable for the whole team to meet. The employees at the second site can work quite independently if they know which dependencies and deliverables they have, and use their own mid-term-board. The two mid-term boards at the different sites can include a swim lane for the other site, but it might not have to be as detailed as the rest of the mid-term board. Finally, he highlights it is the way of working that is important, not the tool. Swan (2015)

However, Kaya et al (2014a) believes whiteboard fails to synchronise an organisation if it is divided between sites, and Mascitelli (2011) also argue that a whiteboard will not work satisfactory in these situations. Kaya et al (2014a) have observe a company that use physical board and video stream to connect the other sites to the board and meetings, however it have not work satisfactory as for instance the other site cannot see the details at the board. Kaya et al (2014b) believe it is beneficial if the employees located at the other site can interact with the board themselves, and Mascitelli (2011) adds it should be possible to do in real time and that everyone should have access to the current version of the board. Mascitelli (2011) recommends a virtual VP-board within example Vision that look like a copy of a physical VP-board. Kaya et al (2014b) also state it should not be up to the project manager to keep the board at the other site updated, it need to happen automatically. Kaya et al (2014b) performed some test at a case company and believed it was only the tool that must improve to facilitate multi-site, within the methodology was only some minor updates suggested.

Kaya et al (2014a) present and test a new methodology for virtual teams, which is called hybrid board. The master board is a physical board at the main site, it is automatically copied through an IT-system to the other site, i.e. becomes a digital copy of the board which always are up to date. Kaya et al (2014a) are little worried that the employees at the main sit will use the digital version instead of attending to the meetings and therefor suggest that only the employees at the distance site should have access to the digital version. The drawback of this methodology is that it only facilitate one way communication though the board, i.e. physical to digital. The employees at the other site cannot interact with the board, but they see what changes the main site do at the board. To be able to interact with the board, Kaya et al (2014a) recommend one should use a digital board for multisite teams, but that a hybrid board could be beneficial in a transition period. Kaya et al (2014a) also compare physical boards with a digital board, Table 3-12, and adds that one drawback with a digital board is that one need to start the computer and login to the system before one can see the board and start the meeting.

Table 3-12: Physical board vs Digital board (adaption from Kaya et al, 2014a, p. 280)

Physical Board	Digital Board
The board is cheap	The board is expensive
Data on the board is temporary	Data on the board is everlasting on the servers
Not possible to backtrack data	Possible to backtrack data (get history)
Hard to save, copy and share the data	Easy to save, copy and share the data
Only accessible within local premises	Accessible from anywhere
Haptic feeling of using real objects	No (or simulated) haptic feeling
Does not provide support for global meetings	Provides support for global meetings

4 A selection of project planning tools

For planning projects there are several tools one can use. The ones considered for this study is sticky notes on a wall, YoLean, iObeya, Team Foundation Server (TFS) and Excel. Another very common tool is MS Project which does not support visual planning, but for background purpose it is also shortly described. All the mentioned tools are used in companies today, but there is not much research done considering them and therefore a lot of the information is gathered from their individual homepages and what is considered general knowledge.

All tools except iObeya have been seen in action.

Table 13: Overview of tools

Tool	Methods/frameworks the tool supports	Digital	Companies included in the study
<i>iObeya</i>	Open design	Yes	Volvo Trucks*
<i>Ms Excel</i>	Open design	Yes	Assa Abloy, Emerson
<i>Ms Project</i>	Gantt-scheduling	Yes	Emerson
<i>Sticky notes on a wall</i>	Open design	No	Assa Abloy , Autoliv, Emerson, Ericsson, Scania, Toyota, UniCarriers and Volvo Cars
<i>Team Foundation Server (TFS)</i>	Scrum	Yes	Emerson, Ericsson and Toyota
<i>YoLean</i>	Visual planning	Yes	Autoliv, Rejmes and Toyota

* Volvo Trucks is not included as a reference company in the study, but as input to the tool iObeya.

4.1 iObeya

iObeya is a tool for visual management that has the same possibilities as a whiteboard but is digital. iObeya can be accessed from several users at the same time from different locations. Examples of what the tool can be used for is brainstorming, value stream mapping, agile practices, project management and lean management. (iObeya, 2015)

4.1.1 iObeya at Volvo trucks

Due to a lack of information concerning iObeya, Volvo Trucks was contacted and a deputy program manager (A) and an employee within organisation development (B) has been interviewed.

Volvo Trucks has used iObeya since the fall of 2012 and managers and project leaders can chose to use it if they wish. There is a large freedom of choice in iObeya and therefore it has many possibilities, but at Volvo each iObeya-room has a specific purpose: Pulse, Obeya (project room), or Daily Team Leadership. Interviewee (B) believes the tool is too wide for visual planning and that project leaders all create their own version of rooms and boards and therefore employees that are involved in different projects experience a partly new standard each time. Also the notes in iObeya cannot be connected or traced and there is not an easy way for follow up which interviewee (B) believe to be the purpose of visual planning. Interviewee (A) believe that too much focus should not be placed on

the tool but rather on the method. Interviewee (A) add that standardized iObeya panels are offered, but that panels can also be customized for specific needs, which is good.

During meetings the meeting leader has to be clear which part of the board is of current interest, according to interviewee (B) there has been times when the group has noticed, after several minutes, that they are discussing different topics. Overall it is vital that the leader of the meeting ensures that everyone get to share their opinions and contribute to discussions since a virtual tool such as iObeya does not affect oral contributions to the meeting. Interviewee (A) believes that meeting leaders and the teams need support to learn to use the tool in the best way.

Before iObeya PowerPoint was used in multi-site projects and everyone individually updated their information before the meeting. The perceived experience was very much the same as iObeya. However, iObeya allows multiple simultaneous users and thereby makes interaction possible in a very different way than what can be done in a static tools as PowerPoint. E.g. brainstorming can be performed on virtual whiteboards. For meetings with iObeya Volvo Group use smart-boards and an integrated audio and microphone. Sometimes the audio system malfunctions and simpler tools are used for verbal communication. Also iObeya demands an installation of a software on each computer that should use the program.

4.2 Ms Excel

Excel is also product from Microsoft and almost every company have this software. Its use is versatile, but in this case focus on ways to support planning systems based is in focus. The program supports both agile and visual planning methods and data can easily be compiled and graphically be displayed. Control to files can be shared.

4.3 Ms Project

This is another product from Microsoft, but this has the purpose of supporting project planning through Gantt schedules. There are no limits for how much information can be included in a project and tasks can be prioritised and highlighted. Several can have access to a schedule at the same time. (Microsoft, 2015)

4.4 Post-it's on a wall

The tool has endless possibilities, but is often constricted to the amount of space, colours and sizes. In visual planning it is the most common tool. It is simple and only demands post-its, pens and a wall, but there is often a whiteboard or paper behind the post-its.

4.5 Team Foundation Server

The software supports agile development and especially for the development of new software since it is closely connected to Visual Studio, a Microsoft developed tool for programming. Together the products handle agile planning and collaboration, version control, management of testing new code, catching bugs, and reporting the current state of the project. (Microsoft, 2015)

4.6 YoLean

The tool is developed at Chalmers University of Technology and is not yet released commercially, there are still updates released continuously. It is a software that includes solutions for Visual Planning, pulse and status check, A3 problem solving and Checksheets. Its vision is to create a digital and collaborative lean product that support knowledge management. In this study only the solution for Visual Planning is considered. The tool is very similar to sticky notes on a wall as it tries to copy several of the constraints to be as close to the method visual planning as possible. Unlike the original tool this one can be used from several sites at the same time since it is digital. (YoLean, 2015)

The structure behind YoLean is stored in Trac, an open source program that can be used for project management. Each object such as a note in the Visual Planning has an ID and can be linked to other data and statistics can be extracted from all the data entered. (Edgewall Software, 2015)

5 Empirical findings at the Reference Companies

This chapter consists of material from interviews with the reference companies. The material represents specific functions of the included companies in this study, and refers to the interviewees' description of their respective company. The reference companies are included one by one and use the same headlines to make it easier to navigate between the reference companies. The sub-chapters are named "... planning..." to include both Visual Planning and Scrum.

Table 5-1 displays the reference companies and the case company Emerson.

Table 5-1: Overview of the reference companies and the case company (Emerson)

Company	Function involved in the study	Method/ Framework	Where is it used?	Tool	Multi-site teams
<i>Assa Abloy</i>	Product Development	Scrum	Project	Post-it/ Excel	Yes
<i>Autoliv</i>	Product Development	Visual Planning	Line organisation and project	YoLean	Yes
<i>Emerson</i>	Product Development	Visual Planning, Scrum within software development	Project, and sometimes in the line organisation	Post-it and TFS	Yes
<i>Ericsson</i>	In-house Product and Software Development	Scrum	Function	TFS	Yes
<i>Rejmes Car</i>	Management team	Visual Planning	Management team and in projects	YoLean	Sometimes meetings over distance
<i>Scania</i>	Product Development	Visual Planning	Line organisation	Post-it/ Magnets	Collaboration, but not teams
<i>UniCarriers</i>	Product Development, mechanical	Visual Planning	Line organisation	Post-it	No
<i>Volvo Cars</i>	Operational Development	Visual Planning	Line organisation	Post-it	Collaboration, but not teams
<i>Toyota Material Handling</i>	Product and Software Development	Visual Planning and Scrum within software development	Line organisation, function & in projects	YoLean and Jira	No

Table 5-1 illustrate the companies use Visual Planning within different parts of their organisation, e.g. project, line or/and function, and which of the companies that have multi-site teams. Not only companies that use Visual Planning have been included, but also companies that use the framework Scrum due similarities between these two methods, especially concerning the short-term meetings.

5.1 Assa Abloy

Assa Abloy is a global provider of intelligent lock and security solutions, with 44 000 employees worldwide (ASSA ABLOY, 2015). The interviewee is their Global Lean Innovation Manager, whose responsibilities include the facilitation of visual planning and to support and educate the organisation within Lean Innovation.

Assa Abloy uses a visual planning room called pulse room, for innovation within their product development, and has pulse meetings both at a team level and within top management. Their goal is to have pulse rooms at two third of their innovation sites world-wide. The interviewee says it takes longer time to gain positive effect of a pulse room within cultures with strong hierarchies.

The interviewee argues that visual management demands a scope, since it is hard to work with a long linear timeframe with many unknown areas and unplanned activities. Instead, the interviewee thinks it is beneficial to work in steps, e.g. sprints in the agile framework Scrum, and work in parallel and communicate a lot. A sprint can vary in length depending on the project. The interviewee believes it is important that projects can handle unpredictability and complexity which demands flexibility. The project leaders usually say they can handle 20 % uncertainties within a project. If the uncertainties are bigger, more work is needed before the project can start.

5.1.1 Planning at one site

When a project is initiated a brochure is created by the project team and the product leader. The aim with the brochure is for everyone to have a common view of the project and the product, and to identify possible risks and possible knowledge gaps. It is also conceivable to reject the idea at this stage. A completed brochure contains a main plan for the project. The main plan is later divided into more detailed plans throughout the project, which makes it possible to learn from the previous detailed plans. The management use GATEWAY gates to see which phase projects are within, while the teams use goals that are more tangible, more dynamic and more focused on results than the gates. If it is required to re-plan, deadlines are moved within the main plan, but the final date still stands.

The project team's scrum board includes activities and they have daily scrum meetings Monday to Thursday. The daily meetings includes three standard questions for every team member to answer, see Table 5-2.

Table 5-2: Standard questions at the daily scrum meetings

- What have I completed?
- What do I work with/should I start to work with?
- Do I have any problems?

The scrum board is physical and consist of post-its and is divided into: TODO, ONGOING and DONE, Figure 5-1. The scrum board also includes an inbox which gives the team input and is emptied at the daily meetings.

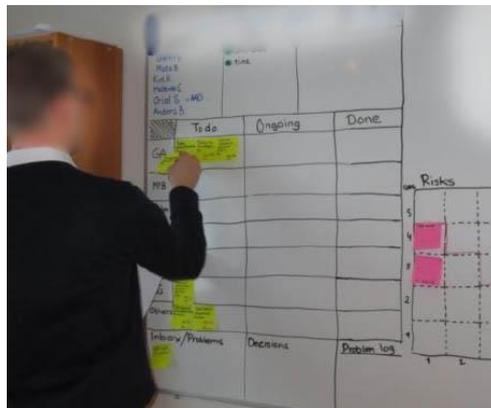


Figure 5-1: Example of a scrum board at Assa Abloy (used with permission)

The management team have pulse meetings on Fridays, and they focus on an overview of the projects; its status and to help where it is needed. Another visual management tool used at Assa Abloy is a resource board, see Figure 5-2. It consists of magnets for where the employees are, and is a tool for handling staff resources and prioritisation.



Figure 5-2: Resource board at Assa Abloy (used with permission)

5.1.2 Planning at multi-sites

In projects with multi-sites involved, the way of working is adapted to each team, and depends on where the team members are located. The main visual plan is always located on the main site, and the interviewee believes that photographs of the main visual plan to team members at the other site(s) can be enough. If the project leader or several team members are located off site, is sometimes a copy of the board used at the other sites which mimics the main board. The copies only contain the part of the project which runs at the specific site. Someone at the main site helps the team members of site to write their notes at the physical main board.

A pilot has been performed at the office in Stockholm for 2-3 years. In the pilot were physical boards and web cameras used to show the boards and the meetings participants, which worked fine. Also, experiments with a visual board in Excel has been tested during the last 1-1.5 years. The visual board in Excel looks like the physical board; the yellow sticky notes have been replaced with yellow boxes in Excel. The visual board in Excel, i.e. the screen, is shared to the other sites involved in the project by the web platform Webex. This makes it possible for everyone to see what happens. However, only

one person at a time can update the board and control over the screen has to be given. These meetings are managed by the main site, and they communicate orally through phone and visually through Excel. Assa Abloy feels that they are limited by the communication technology they have chosen to use today, and would like the team members to have the possibility see each other during meetings.

The interviewee thinks these ways to use visual control at multi sites work okay, but feels that the commitment is lower, and the meetings are less efficient and run approximately three times slower.

5.1.3 The interviewee's opinions about planning

Assa Abloy focus on the team, which set certain demands, and the planning should focus on the developing product and its result. To get the desired focus they use dedicated teams, i.e. one team per project, clear goals for the team to work towards and the sprints are separated from the gate system. The interviewee believes that a pre-request for being able to deliver on time is for sprints to vary in length depending on the project, i.e. they are dynamic. They also use an Andon-system, where the team continuously should consider if they can deliver what they should so that troubles can be addressed as soon as possible. The interviewee believes it is better for the teams to know their status, than to work towards too many dates and deadlines. The interviewee describes other success factors, their creation of a portfolio and the selection of the best ideas and their use of daily control meetings (pulse/scrum meetings). The interviewee also adds that they strive to find the root cause of a problem and that a solution should address it.

The interviewee believes the framework for visual control should be easy and basic. Some benefits they gain when they use Excel instead of a dedicated software is to keep it simple, and have the possibilities to experiment by themselves to find the best way to use it. Dedicated software takes longer time to learn and someone else has decided on how you are supposed to use it. The interviewee also thinks it is better to "go to Gemba¹" than to study the statistics.

5.2 Autoliv

Autoliv is a safety company with focus on the automotive industry (Autoliv, 2015). It is a global company with 60 000 employees around the world, with headquarters in Sweden (Stockholm) (Autoliv, 2015). Over 1200 of the employees are located Sweden (Autoliv, 2015). The interviews were with employees involved in product development: two line managers and a group member. All located at their facility in Vårgårda, and they are referred to as interviewee (A), (B) and (C) respectively.

Autoliv collaborates between its offices around the world, and the meetings are affected by time zones and varying technical solutions. All development projects at the company is directly linked to a customer (within the automotive industry). Autoliv has a List of Open Points (LOP) for specification of progress and what is yet to be done in the project as a base for communication with the customer. Autoliv use visual planning both within the line organisation and projects and have done so for the last eight years. For the last two years Autoliv has tested the software YoLean in some of the line departments and projects. In the projects they use wingboards; whiteboards on wheels, for their visual planning, outcomes and follow-up. Since YoLean was introduced in the departments the information such as; list for priority of problems, improvement suggestions and 5S is left on the wingboard. Other information has been moved to YoLean.

¹ Go to the place where it actual happens to gain first-hand knowledge about a situation. (Liker, 2004)

5.2.1 Planning at one site

Within the projects three time horizons are used for the VP-boards, and those are the same for projects at multi-sites. The time horizons are long-term (24-36 months), mid-term (10 weeks) and short-term (2-3 weeks). The three time horizons have slightly different purpose. Long-term involves internal deliveries (e.g. Gates) and deliveries to customers (e.g. prototypes, freeze of design and start of production). Mid-term consists of activities to answer how the deliveries in the long-term should be achieved, and in turn short-term involves activities to achieve the midterm plan. The activities in the short-term have a more practical approach than the ones in the mid-term due to the duration (maximum four hours) of the tasks. Autoliv considers it very important to keep long-term deadline since the products often are linked to larger projects at the customer. Missed deadlines can ensue in extensive financial penalties.

One employee can have his or her name at several boards as they are involved in multiple projects, however they strive for employees being involved in only two projects. In addition everyone have a lane in the VP-board within their respective department, which consist of a short-term horizon, i.e. 2-3 weeks. Everyone is responsible for keeping their lane updated. At the short-term VP-boards, both within the projects and the line organisation, they dedicate resources for the activities and one activity (i.e. one note) should have a maximum of four hours. The employees should plan 32 hours every week and leave seven hours for unplanned activities (a work weeks consists of 39 hours). In the department this results in a plan for what each employee should achieve every week. The visual plan has a different colour on the note for each customer, simplifying the overview of resources allocated to each project. In addition, one colour is used for other activities such as meetings and holidays.

Departments are placed in office landscapes and have touchscreens along the walls where the visual plans can be seen in YoLean. The screens are either 27 tum or 42 tum, and meetings are held at these if all employees/members are located at the same site. The employees also have access to YoLean at their computers. One of the interviewed line manager has around fifteen employees within the group and believes that meetings where focus is on short-term plans quickly become uninteresting. Therefore, the group members have five to ten minute meetings; one on one with the line manager at the screen. The meeting is once a week and focus is on the next week. Prior to the meeting the employee has updated his or hers lane. For the leader standing at the screen through all the meetings says it can cause quite a lot of strain to the eyes.

5.2.2 Planning at multi-sites

In groups where the members are located at different sites the meetings are held at their respective computers through a web platform Lync. Headsets are used to ensure good verbal communication, and the size of those teams are commonly from three to seven members.

The interviewed (A) leader's group is divided geographically, half at Vårgårda and half in Poland. YoLean has been used for two years in the group for resource planning and is mentioned at Autoliv as eVP (electronic Visual Planning). They only use YoLean on their own computers, and not on larger screens. The interviewee has individual meetings with the group members every week through Lync. Before the use of eVP, Excel was used for resource planning, and it was updated each Monday and after a few days the sheet was no longer current as projects change rapidly. The eVP, however, is updated continuously, but there is a lack of function for presenting statistics with YoLean which previously was achieved through the plan in Excel.

Two years ago this multi-site group had trouble to deliver on time. Since then the group has started to use eVP and received increased resources and today the group performs well. The interviewee cannot be sure if the introduction of eVP has had a large impact on the improved performance, but it has made the overview easier.

5.2.3 The interviewees' opinions about planning

Interviewee (A) believes the goal with eVP is for the planning to be digital and transparent, and wish it would be possible to connect their PLM-system² to the tool. Today the same information has to be added twice, once to the PLM-system and once to eVP. The activities are activated from the PLM-system through emails, and then put into YoLean and when completed the chain goes in reverse. Interviewee (B) would like the possibility to connect the eVP to other information, for instance to the LOP, to not have to search for information at different places.

Interviewee (A) believes the time spent on administration has been reduced from 60 minutes to fifteen in their multi-site team. Now, unlike before, reflection on lessons learned is also included in the administration time. Interviewee (B) also estimates around an hour in decreased planning time each week since the start of eVP. However, interviewee (C) thinks it is around 30 minutes each week, but that is only personal planning unlike (A) and (B) who have group responsibilities. Interviewee (B) points out that 30 min per week is not a lot on a larger scheme. Interviewee (C) points out that redundant planning has decreased, since eVP allows for access at the personal computer instead on a board some distance away. Interviewee (C) only have access to the short-term view (two weeks) of the personal planning, and would like to be able to zoom out to avoid multiple clicks in eVP for dates further in the future, similar function to what exists in Outlook.

Interviewee (B), group leader, says that several of the employees at the company's facility in Vårgårda are quite young and that therefore it is easier to adapt to a virtual tool such as YoLean. The group leader also mentions that some older employees feel that the feedback from moving a note has been lost when using eVP. All the interviewees approve of eVP, and the interviewed leaders think it is easier to get an overview now. Interviewee (C) highlight the positive aspect of always having the planning with you and it being up to date. Interviewee (A) think that the company has started to create too many visual boards without having a good structure and therefore the overview becomes cluttered.

Interviewee (B) also highlights that it is important that every member get practical use from the tool otherwise there is a risk that the daily planning can be perceived as a control tool, and that it is used only to keep the manager satisfied. Interviewee (C) raise that it is never easy to be understood when meetings are held over distance, it applies to both longer and shorter distances. Interviewee (A) does not recognise enough specific pros and cons comparing physical visual planning to eVP to support an investment if the entire group is located at the same site.

5.3 Ericsson

Ericsson is a global company within communications technology and services (radio, cloud & IP, global services and support solutions), and have around 118 000 employees of which more than 25 000 within R&D (Ericsson, 2015). The number of employees in Borås was approximately one thousand in

² PLM-system refers to a Product Lifecycle Management-system, which is by Product Lifecycle Management (2015) described as "managing all data relating to the design, production, support and ultimate disposal of manufactured goods".

the beginning of 2015 (Sveriges Radio, 2015). The interviewee is a Scrum master within software engineering, and has many years of experience within project management and leadership. The interviewee is seen as a project manager with responsibilities for budget and scope by Ericsson and the interviewee's managers. However, the interviewee identifies the position more to a Scrum master and not a project leader as the key to success with Scrum is that everyone should feel responsibility in the team according to the interviewee.

The interviewee has a global team with half of its members in Borås and the other half in a city in India with six to seven employees at each site. The team's current product development is software updates and it has run for one and a half years. The interviewee avoid the term project in the team since the framework used is Scrum and then one works with features, not projects. However, from the company's view, a team can work with several projects. A team consists of employees with similar competence, it allows for increased flexibility if someone is absent. In software and hardware teams within product development the work is conducted in similar fashion through Scrum. In hardware development the gate system is abandoned at the higher management levels, and they only work with features (i.e. decisions) which are prioritised. Within software development they try to move in the same direction by freezing the features three months ahead to allow higher flexibility in the teams. However, to leave the gate-system completely is yet not possible due to managers and product owner still using the waterfall planning method³.

5.3.1 Planning at one site

Within software development the software tool Team Foundation Server (TFS) is used and the interviewee's team has used it for one and a half years. The team has in total worked with agile methods for two and a half years. The hardware development teams are located in Borås and do not have a virtual tool, but relies on whiteboards and post-its. Their whiteboards are located near their workstations and includes: Backlog, Active (each team member has one row), and Completed. A team's full backlog is displayed in a printed Excel sheet, which the post-its at the whiteboard are copied from. Since hardware development is located at one site the interviewee believes that the physical board with post-it works fine. However, one drawback is that all background information that is possible to save within TFS is lost. In TFS it is also possible to get burn rate, i.e. number of done tasks versus planned tasks. However, they have started to discuss if they should swift to TFS within hardware development as well.

5.3.2 Planning at multi-sites

The length of the long-term plan used by the interviewee is about two years and consists of a road map with milestones. The road map is defined and visualised through Power Point. The milestones define what should be done, but not how. The roadmap's milestones are defined into one of four types to clarify their status: released, planned, indicated, and candidate. The milestones are broken down into initiatives and features in monthly sprints, i.e. they have defined one month to be four weeks. The sprints become more detailed the closer they come until they divided into product backlog items by employees who are not a part of the team. However, the backlog is created in close contact with team members.

³ The waterfall planning method refers to a process used in software development where new software is produced through a single flow containing different phases (Waterfall model, 2015).

Since November the interviewee has tested to have cross functional meetings (CFM). The meetings occur every Monday morning and they focus on the upcoming three months in the roadmap. At the cross functional meetings (CFM) eight functions are represented, and the interviewee wants these functions to be autonomous and to be responsible for their parts but using this forum for coordination. These meetings are three hours long, and it has been agreed that one can do other work during the meeting as long as one is ready to jump in when something becomes relevant for them. Everyone is therefore present throughout the meeting by phone conference, however the interviewee wish to use video equipment in the future.

The interviewee's team has since August used four weeks sprints. Every fourth week they complete the current sprint and prepare the next sprint period. They document the current sprint, perform a sprint review (what they have done and to learn to the next sprint) and a sprint demo (show their work for stakeholders). They also do a retro (give each other feedback, suggestions for improvement and lessons) and plan the next sprint. When they perform the sprint plan, the team members usually already know what they will do, and the creation of it takes around three hours. Twice a week they update/refines the sprint plan during one hour meetings, which is very appreciated and they also look three months into the future at these meetings. Every meeting have a different agenda to discuss what is currently of highest importance. The meetings for planning and reviewing the sprints are held currently through telephone conference, but will be through video conference as soon as equipment has arrived and been installed.

Ericsson Borås has a room dedicated for Scrum meetings close to the open plan offices, and it is booked in eight 15 minutes slots every morning. The room is approximately 20 square meters and includes high tables, microphones, speakers and two screens: one for TFS and one for video conference, Figure 5-3. The screen used for TFS is a touch screen and about 100 inches, however the interviewee says they seldom use the touch and instead use a keyboard and mouse.

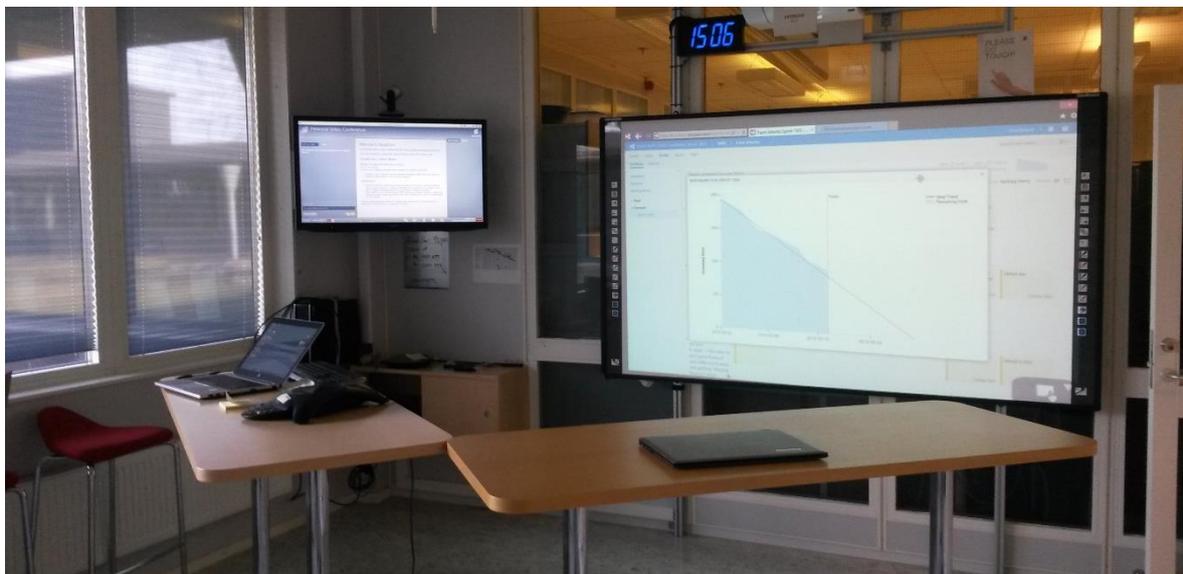


Figure 5-3: The pulse room at Ericsson Borås (used with permission)

The interviewee's team have daily scrum meetings; half of the team is in Borås and use the Scrum room, Figure 5-3 and Figure 5-4, and the other half of the team use a conference room in India. Sometimes, other plants are involved as well. The room in Borås have audio- and video equipment to facilitate the communication at the meetings, and these are placed strategically to improve the quality

of the meeting. The microphones and the speaker are placed in the ceiling above the tables to increase the feeling of every team member's presence. They are of high quality to ensure that everyone, no matter site, can follow and participate in the conversations. The video camera is placed over the small screen in the corner where the second site is seen, which makes it natural to speak directly to them. Also, the video camera films with wide angle which make it possible for the team members in India to see all team members in Borås at once. However, the quality of the video transmission are sometimes low between Borås and India, but usually the audio still works satisfactory and the camera is simply switched off. As the timeslot is only 15 minutes there is no time for fixing technical issues. Therefore the room also contains a conference phone in case the audio quality also is low.

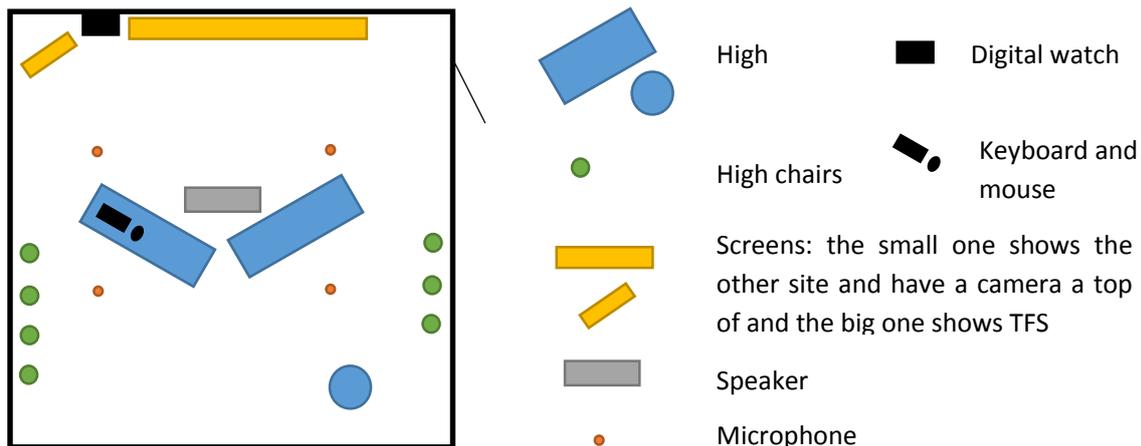


Figure 5-4: Schematic overview of the pulse room at Ericsson Borås

The Scrum meetings are in the morning in Borås, which corresponds to around lunch time in India. During the meetings all participants go through yesterday, today and if they have any obstacles for reaching the result until tomorrow. It is a habit that the members in Borås start. The view used in TFS during the meeting displays: To Do, In Progress and Done, and prior to the meeting each team member should assign tasks to themselves. In Borås a single wireless keyboard and mouse are set on the high tables and these are connected to both screens and the participants take turns using them. The screen where TFS is displayed is shared with the team members in India, which make it possible for them to see every move in TFS. For India to be able to do changes within TFS, the participants in Borås will give them control over their desktop.

5.3.3 The interviewee's opinions about planning

The interviewee highlights the team, and emphasise that it is one team that are located in two places. It is of high importance that all team members feel they are part of the team, regardless of where they work, and they avoid the terms "we" and "them". When the team receives a new member that person is flown to Sweden for a week of bonding and education in procedures. The activities will be both work-related and social such as dinner at each other's homes. Sometimes this is hindered by financial restrictions, but often some kind of introduction can be achieved. The team have a Facebook group where the members are encouraged to interact privately and other IT-systems are used for work. Amongst others, there is a general policy to say hi/good bye in a chat when they arrive/leave each day, in that way everyone will know who in the team is currently in the office. The interviewee thinks this is the same as saying good morning or good bye to colleagues at the same site. They also have pictures placed at their work place of the team members that are located at the other site. In the future the interviewee wants to have wide-angle camera to constantly send a video-feed between the

sites. The team members will then feel they are even closer to each other and it will be as simple as to wave to the colleagues at the other site if she or he wants help.

The interviewee believes that to meet before you start to work together is very important since it is much easier to collaborate if you have meet. The interviewee also believes it is a huge positive difference to use a webcam during meetings with the other site. For this purpose a portable video and audio equipment has recently been purchased to simplify more multisite communication. The team will then not dependant on a conference room that have video equipment.

The time difference could be a hinder, but the team members in India usually arrive late to work which make the difference smaller. The interviewee also sees some work benefits with the time difference, for instance it is possible to work with the same task more than eight hours per day since a colleague at the other site can continue with it.

The interviewee also highlights the difficulties for everyone to understand the road map and their overall three month sprint plan is a snapshot, and not something defined in stone since there can be other priorities in the future that needs consideration. The interviewee says that it is hard to know what the team will accomplish in April 2016 for instance. However, in the near future it is possible to be more specific and detailed. Another aspect the interviewee has tried to explain many times, especially to managers in more hierarchical countries, is that it is easier, but also more efficient to work with projects in a sequence and to complete one before starting the next rather than running them all in parallel, Figure 5-5. If run in sequence two of three will be finished earlier, and one task at delivery time for all three if run in sequence. It seems clear, but the question arise who will have their project last?

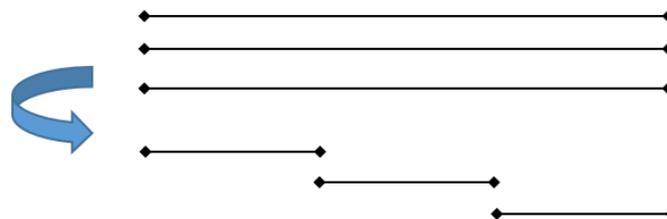


Figure 5-5: Schematic description on two different ways to do three tasks

5.4 Rejmes Car

Rejmes Car is a company in the lower regions of Sweden within the county Halland that sells new and used vehicles, but also auto repair and services (Rejmes Bil, u.d.). The company had in 2012 around 200 employees (Rejmes Bil, u.d.). The interviewee is since 2014 Head of Production Control at the company, with responsibilities for the shaping and control of the company's processes. Before working at Rejmes Car the interviewee was employed for ten years at the consulting firm JMAC, where the interviewee had assignments concerning Visual Planning at Volvo Cars.

Rejmes Car uses Visual Planning in the entire organisation, from top level management to employees selling cars, and the interviewee highlights that the managers have an important role. It is the managers that are responsible to act in their processes, and they lead different development projects that are based on the company's strategy. Visual Planning is used to plan and manage them, and since November 2014, when a pilot ended, it has been executed through YoLean.

5.4.1 Planning at one site

When the company initiates a project the group that will perform it begin with a Barashi exercise. In this exercise is strategic connection, current process, idea, what should be done and initial resource estimation defined. The purpose of this exercise is collaboration, and to create a common view of the project. The Barashi is summarised on an A3-paper, and it is used as a foundation for a Gantt schedule. The Gantt schedules are created on whiteboards and include: areas, responsibilities, start and end of activities, but in the future these will be performed in YoLean. Rejmes Car also use a status board and an issue break down view in YoLean and other documents are uploaded to YoLean such as the initial Barashi.

Rejmes Car use four horizons in YoLean for their Visual Planning: two weeks, three weeks, two months and one year, and Figure 5-6 shows a long-term view. All horizons are displayed on a personal level, i.e. each lane belongs to one individual. Notes marked with a black frame are milestones, while notes with a red frame illustrate an issue or a problem, their colour coding is described in Table 5-3.

Table 5-3: Colour codes used at Rejmes Car

- **Blue** – Delivery responsibilities
- **Green** – Delivery requirements, i.e. needs input from someone. A green note should have a corresponding yellow note at the person’s swim lane from whom I need input from, this note could be marked with a star in YoLean to show that it is a new note the receiver has to accept.
- **Yellow** – Activity
- **Pink** – Activity missile, something that pops up, without going as it should. It should be something serious that raises the priority of the activity or something has to be re-done.
- **Orange** – External activity

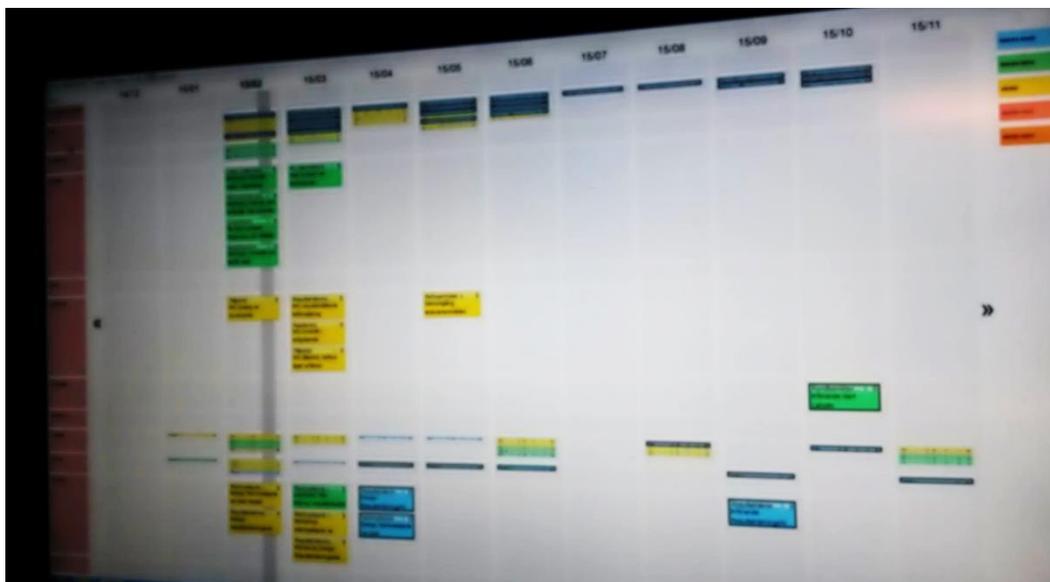


Figure 5-6: A long-term view (1 year) within YoLean at Rejmes Car (used with permission)

When a physical Gantt schedule has been created they included notes for start of delivery, but the interviewee thinks they have lacked continuity in adding the starting notes. The interviewee feel that it is the individuals’ responsibility to know which activities that depends on each other, e.g. activity 2 cannot start until person X is done with activity 1.

They have a pulse room in connection to their offices and sales area, the room is around 15-20 square meters and the walls are covered with visions and different kinds of planning. The room includes some high tables and a large, approximately 90 inches touchscreen. However, they seldom use the touch function for YoLean since it is faster with a mouse and a keyboard, but they use the touch function for other purposes within the company. In February they had not yet started with pulse meetings, but project meetings with YoLean occur regularly every other week. Some project members write notes ahead of the meetings and some at the meetings. However, the interviewee has noticed that some people feel uncomfortable to write their notes on the screen while the others are waiting and watching. Therefore some participants bring their laptops and update their notes at them and the notes then pops up on the large screen.

5.4.2 Planning at multi-sites

The entire management team is located at their main office in Halmstad, and the site managers in other towns are expected to attend project meetings in person. However, it has occurred that someone cannot attend a meeting and call in to it, but is something that they try to avoid.

5.4.3 The interviewee's opinions about planning

The interviewee believes one common fault many do is that they do not see Visual Planning as something for the management team, and management is disconnected from the visualisation. The interviewee also thinks many companies have not studied the leadership model within Toyota Production System carefully. Rejmes car focus on that the leader should coach her or his team and work with the philosophy "Go to Gemba"⁴. When they have meetings in their organisation it is not allowed to be a representative from its function, without the employees should always focus on what will be best for the company. However, the employees contribute with their expert knowledge from their areas. Both the interviewee and the CEO have many years of experience from Toyota and Toyota Production System (TPS), and have been coached within TPS and visual planning and have knowledge of how to adapt it in to their business.

The interviewee says it is very beneficial, and simplifies a lot, that both the owners and the CEO are positive to visual planning and YoLean. The interviewee also thinks it is a big advantage that YoLean can be accessed through the web, i.e. do not need a specific software, and that the planning is always accessible. The group members do not have to walk anywhere to check the planning since many people think it is too long to go to the pulse room even if it is just some meters away. This is a contrast to how it works in Japan, where it is common that they have to roll out their visual plan as well to be able to see it. Some other opinions the interviewee has about YoLean is summarised in Table 5-4.

Table 5-4: The interviewee's opinion about Visual Planning and YoLean

- There will not be an issue about space, i.e. lacking enough wall space, when using a software.
- Resource planning, could help the employees to not plan too many hours per week to find a good work load.
- YoLean is more modern than post-it. The interviewee says that Visual Planning can meet resistance because it seems too simple.

⁴ Go to the place where it actual happens to gain first-hand knowledge about a situation. (Liker, 2004)

- Sometimes YoLean is slow and reloads and it is believed to be due to many users being online at the time.

The interviewee believes the quality concerning planning has increased, since they started to work digital with Visual Planning instead of physically. But, as all models, YoLean need discipline to ensure continuous high quality. Next step for the company is to buy another large screen to be able to have two views open in YoLean at the same time. Table 5-5 includes some features the interviewee wish YoLean to have in the future.

Table 5-5: Wishes for future features in YoLean

- Have different user access, to only allow certain persons to access certain notes
- An app for YoLean so it can work on a tablet, would make it possible to add activities during meetings and likewise
- To be able to copy one note to another board, so the user do not have to write it multiple times
- A personal view so that instead of checking ones lane on each board they are all collected in a personal view. (The interviewee adds that this function will be included in the future in YoLean.) The interviewee believes this is crucial for Visual Planning to work well in a digital software.

Before deciding on YoLean iObeya was also considered, but the interviewee thought it only had a small amount of the functions YoLean has. In iObeya can the user vary the variables as he or she liked, which would make it much harder to create a standard and to be consistent with it. Rejmes Car has decided to use standard categories in YoLean to avoid that the user comes up with several new categories. In addition the notes in iObeya “stupid” when created, and it was not possible to see the relationships between the notes. The interviewee believes it is too easy within software such as MS Project to add extra weeks in to the planning without thinking about the consequences. The interviewee thinks there should be a little troublesome to re-plan, so one gives the best effort to reach the plan, or if it is not possible one should once again consider how the project best can be performed. Therefore it is this function something the interviewee does not miss in YoLean.

5.5 Scania

Scania is a global company that develops and produces customised heavy trucks, buses, engines and services (Scania, 2014). The company has 41 000 employees around the world, and production units in South America and Europe, amongst others in Södertälje in Sweden (Scania, 2014). Their research and development are concentrated to Södertälje with 3 400 employees (Scania, 2014). The interviewee has worked at Scania for thirty years and has for the last fifteen years worked within Business Development and has amongst other things worked with development of methods and frameworks that are used in projects, and coaching teams.

Scania has worked with Visual Planning for at least ten years in their product development projects, and those projects are usually between one to five years. Earlier concept development was included in the product development projects, but has since then been separated to decrease unknown variables in the projects. The interviewee assumes that a project has an 80% likelihood to be delivered on time, without any changes to the expected quality and cost. Employees usually work within several projects and Scania performs a master planning at the project level. However, their Visual Planning

boards are used in the line organisation and it consists of deliveries to the projects the groups are responsible for.

5.5.1 Planning at one site

When a project begins a master plan is created that consists of activities, deliveries and estimated time resources. This process usually proceeds during a month and consists of three hour workshops, if something is left to be done; an extra workshop is added prior to the next workshop to ensure no gaps in the created plan. They have found it important that a representative from each group that will perform activities in the project is included in the planning. The master plans work as foundations for the groups' Visual Planning boards. The master planning usually has a high quality for the next six to nine months.

The Visual Planning board consists of a whiteboard with a time horizon of 30-60 days and it has post-its on it, which represent deliveries to the projects. The interviewee thinks that a weakness with Visual Planning is that everyone expresses themselves differently on the post-its and one has to read every note to get a full understanding. Therefore they have started to use standard symbols on magnets for their deliverables within projects that are cyclic, Figure 5-7 Unlike what many product developers believe, the interviewee thinks that product development contains certain repetitive processes. Even if the product development engineers develop a new thing each time, the functions are often the same. The interviewee believes it is much easier to quickly get an overview over the project and to identify bottlenecks when they use standard symbols instead of sticky notes.

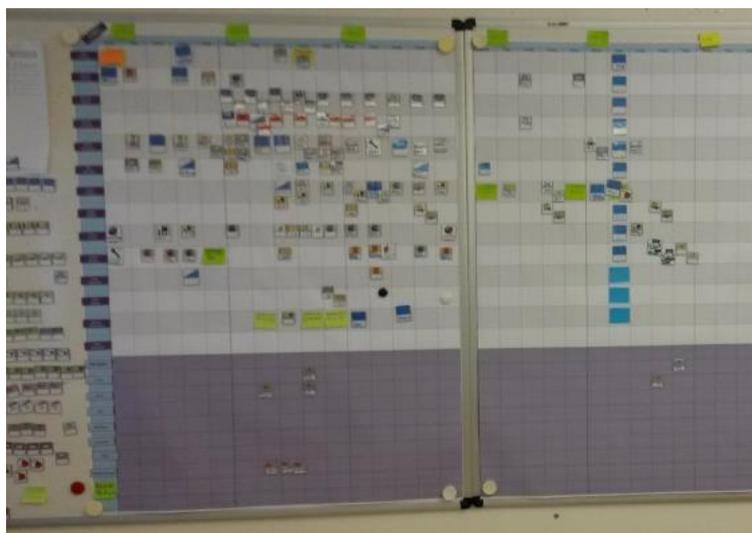


Figure 5-7: Visual Planning board with magnets (used with permission)

The groups within Scania have 15 minutes daily pulse meetings at their boards which are led by the team leader, but the real time depends on the group and its maturity. Before the daily meeting team members are responsible for updating their own lanes, by adding new deliveries, and moving or removing deliveries to the left, i.e. from yesterday/last day. The visual planning board should not have any unattended deliveries on the left side of the time axis; they should have been removed or moved. Scania do not use the system where deliveries are marked when they are moved in to the future, or as the interviewee called it "the penalty system". Instead, if someone misses a delivery he or she should discuss it with their manager and together agree on how to proceed. The employees have time between 8.45 and 9.45 dedicated for daily control, which make it possible for team members that

have something to discuss to do so after that after the daily fifteen minute meeting. After the daily meeting the group and project leaders have a status meeting where they discuss status, risks and handle short problem solving to deal with issues that can be solved at this level in the organisation.

The interviewee believes group leaders and project leaders to have an important role within daily control and Visual Planning, and that they are responsible for their execution.

“By consistently ask the same questions again and again, we learn to answer them”

Scania uses four standard questions, Table 5-6, which the group leader should ask each group member in turn during their daily meetings. The standard questions ensure consequent meetings and the team members get a clear understanding of what is expected of them.

Table 5-6: The group leader’s four standard questions during the daily meeting

1. How is our /your status to the next delivery/milestone/release?
2. What is left to deliver?
3. What are the risks?
4. What do you do to eliminate the risks?

“By constantly talk about yesterday and today, we forget about tomorrow”

Scania focus on tomorrow, the day after that and next week during their daily meetings, because they do not want to get trapped in yesterday. The only time it is okay to speak about yesterday and today is if a group member have lessons he or she wish to share with the team. The interviewee highlights some important aspects to consider at the daily meetings, Table 5-7.

Table 5-7: Aspects to consider at a daily meeting

- The plan should always be in focus, do not discuss other things.
- The leader should by his or her position in the room show that they led.
- The team members should stand close so that they can read the notes, and it will also increase their intensity and commitment at the meeting.
- Arrange the room so no one can hide behind a furniture or stand too far from the board. If the room is too big, it is possible to mark the floor with tape where they should stand.
- Focus on meeting one’s commitment every day, but also look at the longer perspective.
- Most persons are not interested to listen to what others do if it not direct related to what they do, therefore could it be beneficial to have the daily meetings in sub groups.

5.5.2 Planning at multi-sites

Scania mainly run projects at the site in Södertälje, and they believe it is a great strength to have research and development at their most complete production facility. During a project they can get input from other sites, but they do not do a joined planning, because they have no need for it. They have experimented with cameras when they collaborate with other facilities and the interviewee states it has functioned adequately, but not well.

5.5.3 The interviewee’s opinions about planning

The interviewee highlights the importance of planning, especially when there is a deadline to be met otherwise there will be a lot of stress in the end, and it is important to remember that one is not done

when the main plan has been created. The main plan needs continuous attention and the interviewee recommended some aspects concerning the main plan and the planning process, Table 5-8.

Table 5-8: The interviewee's recommendation for the main plan and the planning process

- Begin with what you already know, and start your planning from that.
- The main plan should be located near the Visual Planning board, to facilitate the information exchange between the boards (in both directions).
- Connect the Visual Planning to the main plan; otherwise the time will be filled with other activities. It is human to wish to fill empty blocks in the planning.

The interviewee believes that the Visual Planning board should include deliveries, and not activities or meetings, and does not think this is negotiable. However, the interviewee adds the wise leader should make sure to include the critical activities that lead to the delivery on the board. The interviewee stresses that the leadership is crucial, and that Visual Planning is just a tool, and is very critical to rotated leadership during the daily meetings. The team should determine a standard for how a delivery should be expressed, because it can be expressed in many ways and there is a tendency that the notes get fluffy and hard to understand, therefore it is important to be specific.

The interviewee thinks it is important to create a culture where commitment should be met, and to work after the principle “it is not okay to postpone deliveries and deadlines”, if it is unavoidable one has to mention it in time and not withhold the information until it is too late. If there are delays or troubles meeting a deadline, extra resources are needed, e.g. overtime or focus on the project. If it is not possible, it should be an active decision to postpone a delivery, not something that just happens.

The interviewee has never seen a digital planning system that works, and says that in software, e.g. Excel, it is possible to create conditions and dependencies but this is not how the reality works. Also, when working with a physical visual board everyone will understand and the interviewee compares it to an Ouija board⁵. The interviewee also believes that as a method Visual Planning is so fundamental that it invents itself when there is a need for it.

5.6 Toyota Material Handling

Toyota Material Handling develops and produces forklifts, and they have a production facility in Mjölby with 1850 employees (Toyota Material Handling Sweden, u.d.) Toyota Material Handling Group is a global division with 21 700 employees to the parent company Toyota Industries Corporation (Toyota Material Handling Europe, 2014).

The interviews were conducted with managers at different levels within product development at their plant in Mjölby. The interviewees were a manager within Power and Control, a manager for Electronics and a project leader within Software and Electronics, called interviewee (A), (B) and (C) respectively. Included in the visit at the facilities in Mjölby was also a tour of the production floor. In a later stage in the project a phone interview was held with a project manager and a line manager that have used YoLean for the past few months, called interviewee (D) and (E) respectively.

⁵ An Ouija-board is a physical model of a flight deck and hangar deck, which is used as a real time snapshot to keep track of the aircrafts (Wolverton, 2008).

At Toyota Material Handling a general product development project consists of two main processes, a twelve month Toll Gates (TG) and a 24 months Design Review (DR). They have recently separated concept development, product development of forklifts to market, and improvement and maintenance of existing products into three separate flows. Earlier employees could be involved in all three areas of development, but now a developer is only included in one of the flows. Managers in the line organisation use status boards to keep track of the projects, while the interviewed project leader uses a digital Scrum tool to plan and run the project. Some projects within product development uses visual planning with sticky notes, but it is not an expressed routine.

5.6.1 Planning at one site

The projects at Toyota Material Handling are cross-functional. When a project initiates the project leader performs a Master Time Schedule where TG and DR are included. Sub-project leaders use a Master Time Schedule to plan deliveries/activities for their function, which the team leaders use to plan for their team. Once a week pulse meetings are held where status for the different projects are discussed, included is risks, problems and solutions, and at these meetings all functions are represented. The pulse room is placed between the production area and the product development office and includes white boards along the walls. The pulse board (status board) is illustrated in Figure 5-8 and Figure 5-9, and the manager for each function is responsible to update their status prior to the pulse meeting. Pulse boards are also used in project within the production, and are placed at the production floor. In contrast to the pulse boards used within product development where magnets are used, they are marked with coloured pens which makes it possible to see the history of a project. The coloured pens represents the status of the project.

	X	Y	Z	
Function 1				- Green, No deviation
Function 2				- Yellow, Action plan exist
Function 3				- Red, Action plan is missing
				- White, No input to this project

Figure 5-8: Schematic sketch of at pulse board where X, Y and Z represents three different projects. The status is marked with coloured magnets in the intersection function/project.

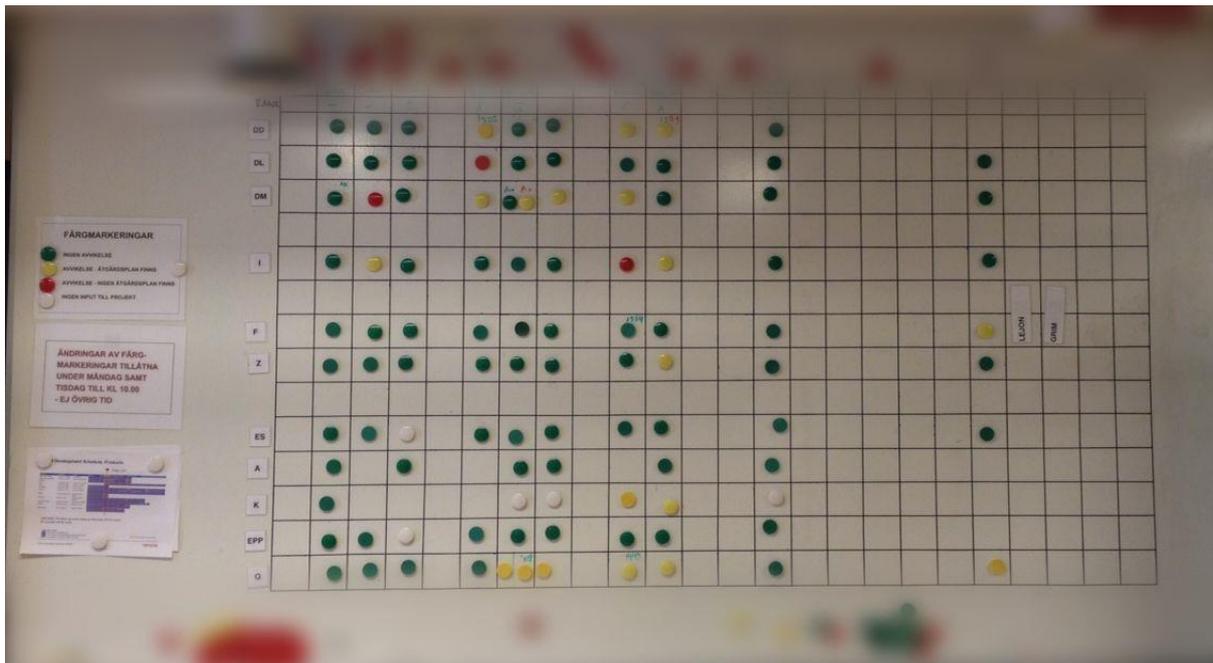


Figure 5-9: Pulse board at Toyota Material Handling (used with permission)

Interviewee (B) has recently started to use a rollout plan in Microsoft Visio to gain overview of a project. The plan includes boxes with deliveries and how these connect to each other within the project. The purpose of this visualised plan is to strengthen the communication between functions involved in the project. A pulse meeting is held every week with the rollout as foundation to discuss how the project is proceeding.

Interviewee (C) has worked with a Scrum software called Jira, creator is Atlassian Cloud, for the last year. The interviewee believes Jira has a very good search feature, and the tasks (tickets) are marked with a label which makes it possible to see which tasks are related and sort according to it. All tickets has a responsible owner and it is also possible to add priority. The interviewee manages a cross functional team, however the main part of the project involves only software development. The project team use three week sprints, and the tickets have three areas where they can be placed: *Backlog*, *Implementing/Working*, and *Done*. The project team have meetings on Tuesdays and Thursdays, and then focus is on the tickets marked with “cross functional”. The software team within the project usually discuss their own tickets outside the meetings as they sit together and work. The meetings take place in the coffee room where there is a large touchscreen (~80 inches), and the meeting participants usually lean on high tables or sit. The project leader leads the meeting using Jira through a keyboard and mouse. Normally there is five project members present at the meeting, the whole team includes fourteen. Some of the project members update their tickets continuously; they are updated prior to the meeting.

A few managers and their groups have recently started to use Yolean, and this is done both in projects and in groups in the line organisation. Interviewee D and E have used Yolean for four, respectively three months. Another employee initiated the introduction of Yolean and decided which features to include. Interviewee (E) welcomes a digital tool since sticky notes feels like they are out-dated. Both interviewee D and E think the company in the long run should decide where Yolean should be used;

i.e. in the projects and/or in the line organisation respectively. They believe it is inconvenient for the employees to be involved at several boards and to have to copy activities back and forth. If this would be the case it would be beneficial to be able to integrate the different boards to one workplace. Prior to Yolean sticky notes were used for Visual Planning. However, interviewee E has used sheets in Excel with action lists of what should be done, which was believed to work well for the midterm perspective (three weeks to three months).

The layout for their version of Yolean consists of a two week horizon, where weekdays are displayed. The notes have room for text, but they do not have a headline or likewise to relate the notes to each other. The teams use different colour codes for the notes. The project leader uses different colours for actions, deliveries and likewise, while the line manager has different colours for different types of activities: pre-development, development projects, series maintenance, information and special products. Their meetings held with Yolean are in a room with an 80 inches touchscreen, but the touch function is not used as they think it is quicker to use a mouse and keyboard. The respective manager leads the meeting and go through the group members' lanes, one by one.

The project leader, interviewee (D), has two pulse meetings each week (15 minutes each) and a planning meeting every second week to plan the upcoming to weeks. The project members are responsible to plan their work in more detail after the planning meetings. At pulse meetings the focus is on deviations from the plan. However, they do not always use Yolean at the pulse meetings, but have an oral check-up instead, this due to the fact that they usually have a god knowledge of what should be done and Yolean takes some time from the meeting. The line manager, interviewee (E), has daily pulse meetings (10 minutes), where focus is on yesterday (have you done what you should) and today (what should you do), sometimes they also talk about tomorrow. It is the employees' responsibility to plan the next few days and within this plan include both project and line activities. Usually activities are marked as "done" during these meetings.

5.6.2 Planning at multi-sites

They do not run product development projects across sites.

5.6.3 The interviewees' opinions about planning

A trend within the company is to work with smaller projects and modules, and within software development they attempt to not assign more than one project to an employee. With their new model of three flows for development projects it is also easier to work more focused than before. The manager within Power and Control, interviewee (A), believes it is harder to use KPI's (Key Performance Indicators) in the product development than in production. This might be a contribution to that it is harder to estimate time for product development project.

Interviewees (B) and (C) think that Scrum and sprints works well in software projects, and believe it is harder to use sprint planning in other parts of product development since "a forklift cannot be delivered every three weeks". However, they also feel that software development not align so well with the Gate-system, for instance some steps in the design review takes hours instead of months.

Both interviewee (D) and (E) think YoLean work fine for a short perspective, up to two weeks according to interviewee (D), but up to two days according to interviewee (E). They also think YoLean is easy and fast to use as many employees can use YoLean at the same time and there is no waiting time due to someone else also writing a note. Another benefit with YoLean is that YoLean is digital which makes it

possible to use it at their workstations, one does not have to go to a physical board. However, interviewee (E) thinks YoLean is too similar to sticky notes, even if that probably is on purpose. Interviewee (E) want YoLean to better take advantages of the fact that it is a digital tool, and wish YoLean better was adapted to their work method and had a more user-friendly interface. For example, it would be beneficial if the edit mode of a note would open by double-clicking on it. Both interviewees think it is difficult to get an overview of the midterm perspective (more than 2 weeks), as one have to click many times to move between the weeks and there version of YoLean only display two weeks are at once.

Interviewee (E) says one issue is that the notes in YoLean become too small, and thinks the layout of YoLean could be improved. It would also be preferable if there was a way to see “active notes” since an activity could be longer than the two week view and is therefore hard to see in the planning. Both agree that more colours would be preferable to use in YoLean, and it would be beneficial if YoLean worked in Microsoft Explorer so it could be integrated with the current IT solutions used in the company. Interviewee (E) believes YoLean works as a short-term solution.

5.7 UniCarriers

UniCarriers Group develops, produces and delivers customised industrial trucks (UniCarriers, u.d.) It is a global company which was created through a merger in 2012 and has over 5000 employees (UniCarriers, u.d.). They have 350 employees within Sweden and was earlier named Atlet. Interviewee (A) at the company is a design engineer and interviewee (B) is a Lean Manager.

The consulting firm, JMAC supported UniCarriers when they introduced Visual Planning in 2007/2008. Interviewee (B) says the company’s Lean journey started by introducing 5S, then daily control within their production. The company wished to have a similar way to manage their business as they did within their production and to work with deliveries both in the short and long run. Therefore Visual Planning was introduced, or as they call it: KI/VP which stands for Knowledge Innovation/Visual Planning. Interviewee (B) guesses they have around ten visual boards within the company. They use three times horizons: short-term (two weeks), mid-term (eight weeks) and long-term (approximately one and a half years).

The company uses Visual Planning in their line organisation, which means that one project is involved at several visual boards while the employees are present at only one. However, some exceptions may exist. The employees are organised in module teams, within the same function which use one common visual board. Four years ago interviewee (A) was involved in a project where Visual Planning was tried to be used within the project, but it became too complex as there were too many individuals involved in the project. At these KI/VP meetings they could be 15-20 people involved, all from different functions. The project leaders use other management tools to manage, control and monitor the projects, and they have project meetings which are led by the project leader with focus on the status and what should happen next in the project.

5.7.1 Planning at one site

UniCarriers uses a standard template for their visual boards, which in the beginning was updated until a found best layout was found that fit the company, since then it has been more or less the same. However the team decides its process for Visual Planning, e.g. meeting intervals and the level of detail on the sticky notes. The team leader is also responsible to update the weeks and other managerial

aspects. Instructions are placed next to the visual boards. The outline of the board is on a paper, but a plastic glass is placed in front of the paper to give the sticky notes better traction. Notes sometimes fall down and a box have even been included on the board for fallen notes. The standard colours of the sticky notes are presented in Table 5-9.

Table 5-9: Standard colours for the sticky notes at UniCarriers

- Yellow – Planned activity, marked with week,
- Orange – Delivery, marked with week,
- Pink – Critical problem,
- Green – Activity that requires input from someone else,
- Blue – Day off/not at the office,
- Light blue – Repetitive activity, e.g. meeting

The visual boards for interviewee (A)'s team is illustrated in Figure 5-10 and Figure 5-11 **Error! Reference source not found.**sits at a wall near the team that sits in a plan office. The short-term planning and midterm planning sit next to each other, and the long term sits on a wall next to them.



Figure 5-10: A picture of the short-term and mid-term boards, taken Monday morning week 10 (used with permission).

Most team members use time estimation for their activity and interviewee (A) thought the time estimations was a good support when one is new at the company, because one do not know how long time a task would require. Sticky notes that is placed at its edge have an unclear time aspect. The short-term and midterm is updated weekly, and the long term board is discussed by the project leaders and the module leader approximately once a month. The project leaders update the deliveries at every teams' long term board, which means that the project leader makes a copy of deliveries to all long-term boards involved in the project.

The team members are responsible to update their lanes at the short-term and mid-term boards prior the meetings to facilitate the meetings to be short and focused. According to interviewee (A) is it quite common that they lag behind their plan, but it is uncommon that they move deadlines forward. There is also a tendency that the more stressful a project gets, the less the visual planning board updated. When a sticky note is moved it is marked with a red dot, and if it gets three red dots it should be placed in the zone "critical", but it is seldom they use the system like that. It is also possible to add critical sticky notes at other team's critical zones.

According to interviewee (B) the usual KI/VP-meetings include 10 employees, and take 20 minutes but they aim for 15 minutes. In small teams the meeting can be 10 minutes. The interviewee (A)'s team



Figure 5-11: A schematic sketch of the long-term board

have KI/VP meetings twice a week, Mondays and Thursdays. However, when interviewee (A) started at the company, around 4 years ago, they had 15 minutes KI/VP meetings every morning but they got too detailed. Today their meetings are 30 minutes every Monday, where they go through what they did last week and what they should do next week. The team leader collects the completed post-its and calculates "delivery percent". They also have shorter meetings during Thursdays, which gives a chance to save the situation if someone has lagged behind by help from other team members.

5.7.2 Planning at multi-sites

UniCarriers do not run product development projects across sites. However, the interviewee (A) identifies a problem that exists due to the teams and their boards are placed around the building, i.e. they are not located at the same place but in close proximity to one's team. The idea is that if you have something that should be delivered from another team you should go to that team's board and add a "green input sticky note" in their critical zone. This mean they would have to go back and forth all the time. Interviewee (A) thinks this way of working does not work in the long run, and they have

tried to mirror visual planning boards in Excel, but it got too much work administratively. However, this way of working is only used locally between some teams.

5.7.3 The interviewees' opinions about planning

Both the interviewees think Visual Planning allows the team to gain better overview, insight in what the others do, and the team leader also gets better knowledge of what the team members do. Interviewee (B) highlights the importance of the team leader to be committed to success with Visual Planning, and also thinks that Visual Planning has led to increased communication within the team. Interviewee (B) also thinks it is important to focus on exchanging information short and concisely, and not to discuss things at the KI/VP meetings. Interviewee (A) believes Visual Planning gives the team members the possibilities to learn from each other, and to help each other. One aspect interviewee (A) stresses is that it is important that the team members have something in common to gain something from Visual Planning, otherwise there seems to be no point with Visual Planning.

5.8 Volvo Cars

Volvo Cars is a global car producer, and have more than 23 000 employees globally, and over 15 000 of them are situated in Sweden (Geely Sweden AB, 2014). Volvo Cars headquarter is in Gothenburg, which amongst other things involves a production plant and product development (Volvo Cars, 2014)). The interviewee is a manager within Operational Development and has a group with five members. The work in the group is mostly cyclic and repetitive, and they have some yearly activities. The information in this chapter considers manufacturing engineering.

Volvo Cars has started to divide projects into three processes with one manager per process: concept, implementation and maintenance. However, many engineers want to be involved in the concept phase where an engineer or designer can set the outlines for design and solutions, the interviewee calls it the "engineering syndrome". However, the interviewee adds that many employees thrives better within the implementation phase because then things happen more quickly. It is important that the boundaries between the phases are clearly defined to not cause irritation between the areas. The project leaders base their plans for their product development projects at Volvo Product Development System, which has around 20 variants depending on the size of the project. Milestones are used by the company management to follow the progress of the projects. Every milestone has a Key Performance Index which functions as a check point, and its status can be visualised throughout the project. The projects also use a gate-system, but they are more specific for the actual product and are used internally within the project. It is usually seven to eight employees involved in a project, and a person is usually involved in several projects. According to the interviewee it is very unusual that the overall time plan, such as milestones, is changed. However, it is quite common that the gates are re-scheduled.

The employees within Manufacturing Engineering are organised within teams by Product System Structure (PSS). The product (the car) is divided into 40 PSS and every group have one or a couple of PSS it is responsible for. The team is involved in several projects, in which they focus on their respective PSS. In theory, Manufacturing Engineering focus on implementation, but in reality they also perform some development of the product. The group leader has staff responsibility, and is also responsible for the quality the group delivers.

5.8.1 Planning at one site

All projects are monitored and controlled through a software, and the team leader can choose to also use Program Control Meetings (PCM), but some think they only take additional time. PCM is a visual status meeting for the projects the team is involved in where a white board is used with red or green magnets depending on the status for the project. They have used PCM for four years, and sees it as a tool the team leader can choose to use if she or he wants.

The interviewee's team has during their last year used Real Time Management (RTM) (authors' note: which is what Volvo Cars names the used type of Visual Planning). The interviewee feels that RTM is quite new for them and is used as a pilot. The interviewee's team use three time horizons for their visual boards: long-term (one year from January to December), midterm (8 weeks) and short-term (two weeks where each day is viewed, Figure 5-12. The visual boards is placed next to their work spaces and are on one row at the wall which saves time.

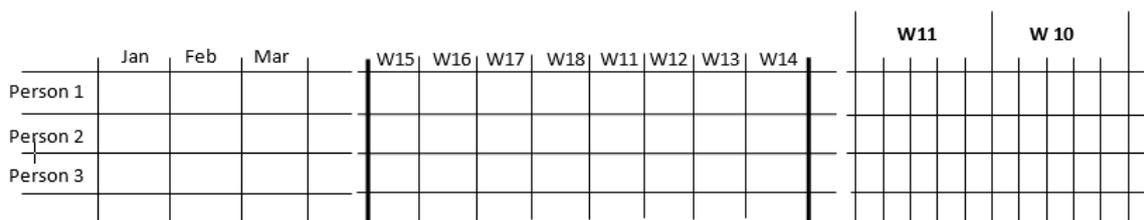


Figure 5-12: A schematic sketch of a Visual Planning board at Volvo Car, the long-term board to the left includes months for a year.

They use yellow sticky notes for their activities, and a number of activities lead to a delivery, a blue sticky note. Red sticky notes are used to display issues, and to signal for help. An orange sticky note illustrates a general event or personal planning. There is no agreed standard for how detailed the activities should be, and they are trying to find the right level of detail. A rule of thumb is maximum 5 post-its per week to avoid copying the calendar. The interviewee thinks that if you just copy your calendar, you could just use your calendar instead of a visual board.

They have three 20 minute meeting every week and the meetings vary depending on which day of the week it is. Even if a group is as large as fifteen members the time limit of 15 minutes is still strived for. The purpose of the meetings are not to discuss solutions, but should be short and concise. In the beginning meetings were held every morning, but not much happened between the meetings which made them to reduce them to the current number of three meetings per week. These meetings have added to the previous meetings and not cancelled any others out.

Prior to the meeting on Monday morning the mid-term and short-term boards should be updated with the current week, and the focus at the meeting is on the near future; what they should do. At the meetings on Wednesdays focus is on the mid-term and long-term view, otherwise there is a risk to only discuss the near future, as it could be comfortable to do. Activities from the long-term board is broken down to the mid-term board, and finished sticky notes from the long-term in a book for traceability. During the Friday-meetings they go through the week; have everyone done what they said they would, and then start to update the activities for the next week.

5.8.2 Planning at multi-sites

The interviewee thinks that Visual Planning works well for groups that are located together. However, if there is a group with members located at different sites the group leader does not believe that Visual Planning will work and have therefore not tried to use it.

The company has chosen to work with research and development centrally and have the implementation at their sites, but they also have a team that travels between other sites to support the implementation. When projects have a product solution that should be implemented at another site, the project team usually consist of employees from one site which receives input from employees at the other site. However these people are not involved in the team and it works well to have phone meetings, and during the implementation the team usually travels to the site where it should be implemented.

5.8.3 The interviewee's opinions about planning

The interviewee says that in general sticky notes are not considered to be cool or modern, but the interviewee believe this feeling it is culture related and something that is possible to overcome. The interviewee thinks it is important that Visual Planning feels relevant for the user, the group. Common areas within the group might be one reason for the use of Visual Planning. However, the interviewee says that the synergies within the line organisation are quite small, but RTM might be a help to find synergies. When implementing RTM, the interviewee believes that one should implement it through the organisation so employees using it see the purpose and benefits of it. But the interviewee thinks they have not find the best way for RTM yet, and wonder if it would not fit better to use it within the project organisation instead of in the line organisation.

6 Empirical findings at Emerson

The findings for this chapter has been collected through interviews and dialogs with the employees at Emerson and observation from several of the teams' Visual Planning meetings. The information in this chapter is either through interviews of observation. At Emerson 14 employees have been interviewed at Göteborg and Linköping. Their positions has either been project leader or team member.

Emerson Process Management is a business area within Emerson and includes several brands including Rosemount. Rosemount Tank Radar (RTR) consist of three business areas: Marine, Tank Gauging and Process Industry. RTR have three locations within Sweden: Göteborg, Jönköping and Linköping, and the R&D is spread out on all three. Rosemount also have some development at their offices in China, Russia, and in the US. Rosemount has within Sweden almost from the start had R&D at several locations, they origin from SAAB which were located in Linköping and opened an office in Göteborg to be closer to their customers. (Kjellström, 2015)

However, within the study the notion Emerson will be used for the case company. Emerson has globally during 2013 launched an initiative to implement Lean within their product development with the purpose to shorten their led time within product development (Kjellström, 2015). Visual Planning is included in this initiative. During the last year Emerson has relocated team members that work together at least 50 % of their time to sit together, introduced Visual Planning and designed dedicated project rooms for Visual Planning, see Figure 6-1. Visual Planning was first introduced as a pilot in one of their projects in May 2014, and as other teams saw benefits of the method and tool and other teams wanted to use it as well.



Figure 6-1: The redesign of a project room for Visual Planning

The interviewed employees had in February used Visual Planning between four and nine months. However, some employees also have experience from the agile framework Scrum either in a physical variant or in TFS. The interviewees have experience of Visual Planning in overlapping projects and in stand-alone projects. The use of Visual Planning is mainly at project level, however some functions use it as well.

6.1 Emerson's use of Visual Planning today

Emerson post-it and whiteboards/papers for their Visual Planning. Emerson uses three time horizons: long-term, mid-term and short-term and breakdown from long-term Visual Planning board (VP-board) to short-term VP-board is illustrated in Figure 6-2. A long-term VP-board represents the whole project and its columns is divided into months, and quarters of the year if the project is very long. The horizontal lanes, which will be referred to as lanes in the text, consist of the functions involved in the project. The long-term is divided into a mid-term which usually consist of twelve weeks. The mid-term is more detailed than the long-term VP-board and functions as a foundation for the two week short-term VP-board which represents what each team member should do in the project the following two weeks.

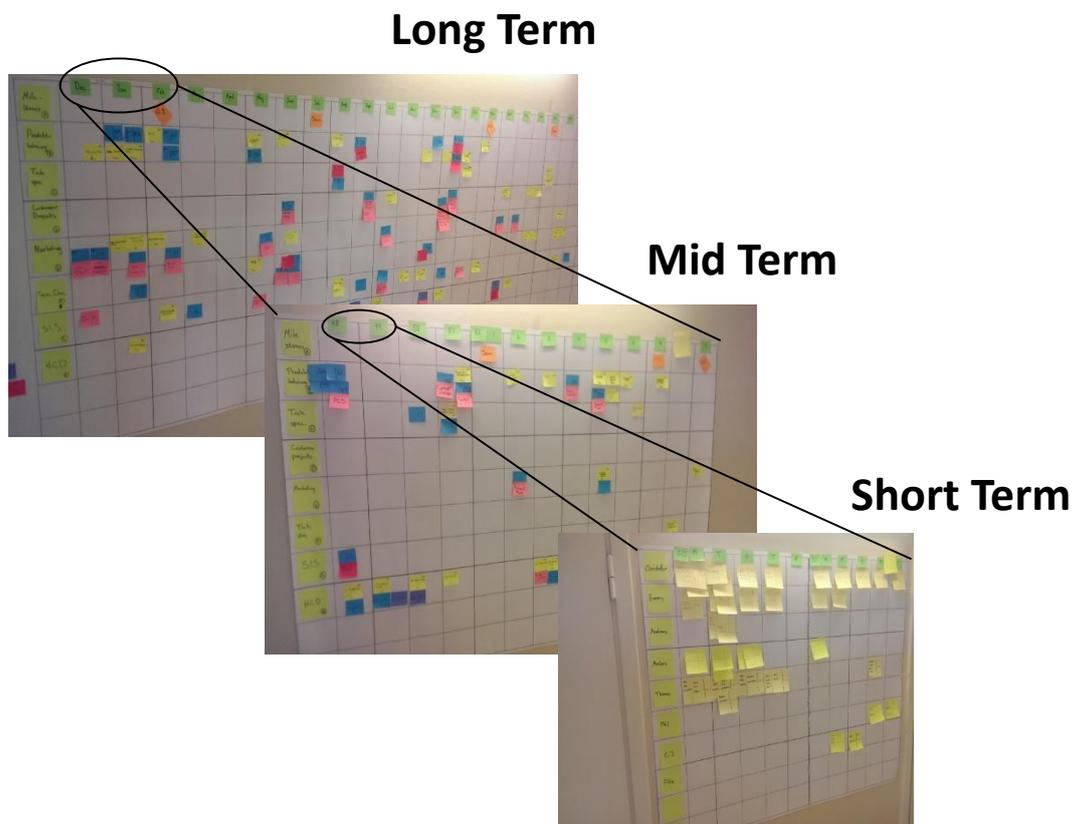


Figure 6-2: The three different views within Visual Planning at Emerson

The long-term and mid-term VP-boards have a similar design, but difference in level of detail. They consist of yellow notes representing activities/deliveries the different functions should perform, Figure 6-4. Those notes should have a corresponding blue note which illustrates start of activity/delivery, Figure 6-3. The boards also include pink notes for activities that are performed by another project, i.e. input is required to this project at this time. They use orange notes for milestones and gates and green notes for months/weeks, which have a separate lane. The short-term planning on the other hand consist the same types of notes excluding the blue “start of activity/delivery” note.

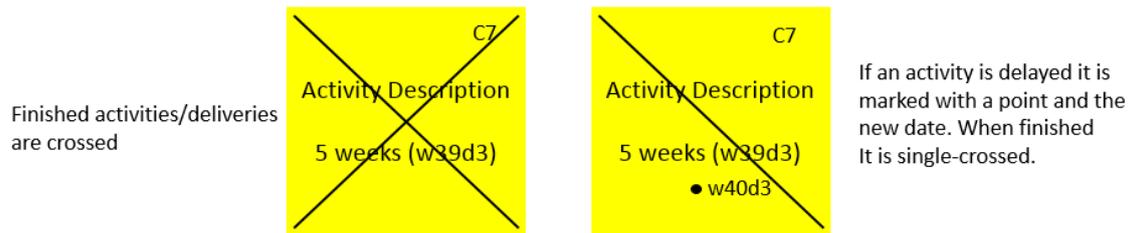


Figure 6-4: Activity/delivery notes at Emerson

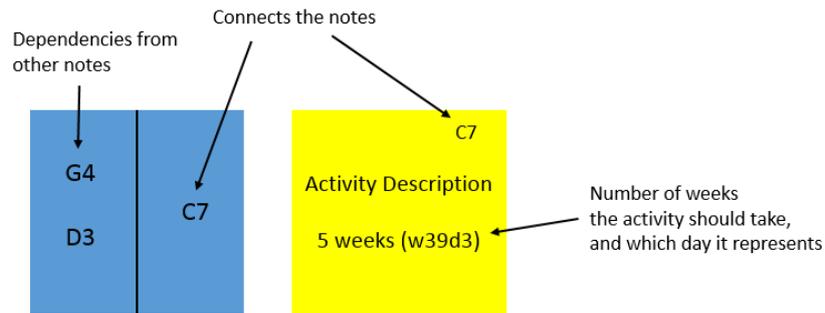


Figure 6-3: Emerson use one blue note for "start of activity" and one yellow note for "finished activity/delivery"

Some teams have adapted the Visual Planning to fit their context better. Not all teams use the blue notes because they believe it is clear anyway since the yellow note includes a start date. A couple of teams work with different colours for different components within the project it is stated that it gives a simpler overview of the parts of the project.

Emerson has in general three kinds of standard meetings related to projects:

- A *project meeting* every other week which include project status according to the mid-term and long-term.
- An *issue break down meeting/risk meeting*, where issues within the project is addressed and these are categorised with regard to probability for it to occur and its impact if it occurs.
- A *short-term meeting* (15 minutes) with the purpose of daily/weekly control where the short-term VP-board is handled. Some teams update their short-term plan at the meeting, while other do it between the meetings. (These meetings are referred to as pulse meetings at Emerson, but in this report the term short-term meetings will be used to not confuse them with the pulse methodology described in Frame of Reference.)

6.1.1 Visual planning at one site

Some of the teams at Emerson only have members at the site in Göteborg. However, they might be located at a different floor in the building which means that some team members have a long way to walk to their Visual Planning board. Depending on where there were room available on the walls when they introduced Visual Planning, the three time horizons are placed more or less near each other. Therefore, sometimes team members have to walk back and forth between plans when the mid-term is planned, in some cases related teams long-term plans are also checked to ensure that their own long-term plan is up to date.

One of the teams have short-term meetings once a week, due to the team being in a low intensive period and the number of meetings will increase when the project demands more communication. The short-term meeting is 15 minutes, however the project leader has booked its team for half an hour to facilitate the first 15 minutes to focus on the Visual Planning and the second 15 minutes for discussion topics raised during the meeting. Those not related to the topics can then avoid being around for irrelevant discussions. Both short-term meetings and mid-term workshops are performed as standing up, and the project leaders usually take a step back at these meetings.

6.1.2 Visual planning at two sites

The VP-boards for multi-site teams are located in Göteborg, since that is where the project leaders are. However, team members in Linköping usually have their own short-term VP-boards in their offices, but also a lane marked with their name at the team's short-term VP-board in Göteborg. Usually, team members in Linköping do not have access to the long-term and mid-term VP-boards since these are located in Göteborg, but some of the project leaders transports the boards when they visit Linköping. One of the teams have discussed having a copy of their mid-term VP-board in Linköping, but then it would have to be kept updated. They have also considered if a camera should be arranged that could film the mid-term plan continuously which would make it possible for the members in Linköping to see it at all times, but the technical aspects has not been solved. Some of the team members in Linköping have arranged a camera that shoot their short-term plan every 15 minutes and automatically updates it in a folder that the project leader in Göteborg can access when she or he wants.

One of the project leaders is located in Linköping and handle a software project that use TFS instead of Visual Planning. The project team tested Visual Planning and did a long-term and a mid-term VP-boards but parts of the team was in another country and it made the structure and updating hard to keep. They tried to use Excel and add the notes from their VP-boards, but it mostly contributed to additional work. One of the project leaders in Göteborg also tried to copy a mid-term/short-term VP-board into Excel to make it visible for the members in Linköping, but the result was not satisfactory.

Instead, TFS is used and deadlines and releases for the project that been approved from the line manager and the team leaders at the sites have been included. The team take responsibility for their detailed plan during the two-week sprints, and it is the team leader (one at each site) who is responsible for this. It is possible to include dependencies within TFS, however they are not so visual. The sprint meetings run at the different site by conference phone and TFS.

The majority teams sited at several locations use Visual Planning and have their meetings through audio equipment, most often conference phone, and some project teams use video equipment. In Göteborg the project teams have dedicated project rooms where the VP-boards are located. However, all teams do not have their long-term and mid-term VP-boards within these rooms, due to lack of space on the walls. Almost every team have stand-up short-term meetings, however the team members in Linköping usually sit. Linköping have a dedicated room for multi-site meetings with audio and video equipment. However, as they usually have a personal visual plan in their offices, and not in the project room the seldom use it.

6.2 Employees' opinions related to Visual Planning

The employees saw several purposes for the use of Visual Planning and only a few did not see reasons to why Emerson choose Visual Planning. However, even if they did not know why Emerson wanted to use it they could see benefits with Visual Planning, e.g. it simplifies and visualises problems in projects. Many of the reasons mentioned by the interviewees was to get a better overview, insight and understanding of the project, and to display correlations but also to be better time estimation and to keep the project within the time limit. One of the project leader said:

“What I think is most important about Visual Planning is that the team gains understanding within each other’s problems and issues...”

One of the interviewees said that it is not only the team members that have got better insight, but also people outside the projects have got better insight in the projects. However, some of the team members do not think there is a big difference compare to how they worked before, except that they now work visually and with post-its. One of the project leaders also believe one reason for Emerson to implement Visual Planning is that it is seen as best practice in industry and the pilot within the company was successful.

6.2.1 General positive aspects about Visual Planning

Several employees highlight that one of the biggest strengths with Visual Planning is the visualisation, it displays correlations and dependencies. It makes it possible to optimise the project and to handle its complexity. One of the project leaders said the strength of Visual Planning is the following:

“Visualise the complexity within a project, involves all project members in the planning. You do it together.”

Some of the project leaders think the commitment from the team members have increased, and that they collaborate and interact better now. The team members now have the possibility to feel included in the planning and to see what everyone else does and when it should be done. One of the team members think the short-term planning is clearer now than before, and one project leader say the two week VP-board is a good way to get an overview of what should be done and what have been done. Several of the project leaders previously used MS Project for planning and managing projects, and believe the new method is more visual for everyone. Before the plan was mostly used by the project leader, and until a year ago all team members did not have access to MS Project. Several of the project leaders think the communication, both within and between the functions, has improved a lot since they started to use Visual Planning. One of the project leaders sees a difference on how they communicate, before most of the communication was between team member and project leader, now the team members communicate more between each other. Another project leader feels there are more discussions now. One project leader said the following about Visual Planning:

“...improves the collaboration and climate within the project between its member”

The team now sees each other more often, has a continuously communication and has more regular check-up, which one of the project leaders highlights as important. Some of the team members think this have helped them to get a better understanding of what they need from others or what others need from them. One of the project leaders also think the team member's competence will increase as the get understanding from the whole project and they have the possibility to give feedback to

other parts than their primary area. Another positive aspect according to one of the project leaders, is the fact that the VP-board is physical which makes it possible to stand next to it during the meetings.

One of the team members think they met their target better now. Earlier features could be added to the project during its course, but now projects are better defined during the long-term planning. One project leader believe it makes it clearer of which parts in a project that will take the most time. The mid-term VP-board is also perceived as beneficial and one of the project leaders think it gives something to relate to and highlights the importance of notes that display “start of activity”. The project leader believe it to be important since it enforces team members to think of when to start an activity instead of focusing on when to finish it. The project leader get a more continuous view of the progress of the project. One of the leader described it as:

“...the most important aspect is that you do not only see what is done, you can also see if it has been started. This is little different approach than used in traditional planning.”

The short-term meetings are highlighted as positive from most employees; however especially team members emphasise the importance of them to be short and concise. The team members want the meeting to focus on short-term planning with the possibility to raise problems. However, several team members think the meetings have a tendency to be too detailed and focus on problem solving. The problem should be lifted and then the issue should be solved outside of the meeting with those who are affected. One of the team members mentioned that what other members do is relevant, but not how they will accomplish it. Short-term meetings are also a better team exercise than ordinary project meetings according to one of the project leaders, because during project meetings is it usually the project leader that takes the lead and talk, the team members mostly listens.

6.2.2 General weak aspects about Visual Planning

The employees think Visual Planning have some drawbacks and improvements areas. One of the team members says Visual Planning feels like three tools and not one, referring to the short-term, mid-term and long-term VP-boards. They need to be better at breaking down variables from the mid-term to the short-term plan. Some of the projects have reduced their number of visual boards to two and their mid-/short-term VP-board is ten weeks, where the weeks closest is more detailed.

A project leader discuss the need of synchronizing planning between teams in large projects, and think it can be hard to get a correct overview of the entire project. Several mention that it is hard to know what level of detail should be presented on the different VP-boards, and one project leader thinks it is especially tricky with the deliveries that are more than one year ahead of time at the long-term board. A project leaders thinks it is harder to see the details in the plans when using Visual Planning, but it is beneficial to be able to include the project team in the discussions about the time plan which was harder with MS Project. However, one of the team members was not so interested in Visual Planning overall and think the project leaders should manage the planning so that one could focus on the mechanics. Another project leader says it is hard to get an overview of the whole project (which consist of several projects), as they have several long-term VP-boards.

Both team members and a project leader believe there is a tendency for VP-boards and meetings to become too detailed, and highlight that they should kept short. A team member said:

“Everyone talks a little too much about their tasks, you gain a little more information than you actual need, and it delays the meeting quite a lot...”

To find the right level of detail at the notes and the short-term meeting seems tricky, however one team member believe:

“It is enough to know what you will do, not how you are going to do it”

One interviewee thinks that short-term meetings and project meetings sometimes are too similar and another does not see the purpose of the short-term meeting as one know what to do for two weeks without these meetings. One team members believe it hard to go from mid-term to short-term as the calendar is already packed with things to do. While others thinks it is hard to plan the activities on a daily basis when they are not working in the project on a daily basis. Another believes Visual Planning needs commitment, and therefore thinks it works best in projects where all members have a lot of activities.

One team member say they spent a lot of time planning; doing their long-term and mid-term VP-boards, but when it is done they do not use them so much and it takes time to look at them again. A project member has joked about being kidnapped to perform the long-term VP-board; there is not enough time to prepare when performing the long-/mid-term VP-boards, which makes it hard to do a good planning. One project leader say they lack knowledge about how long time their product development projects will take. One team member said:

“Visual Planning focus so far a lot on the deliverables within the project and maybe not so much at the status of the actual developing project and the things that is developed...”

More guidelines and education about Visual Planning were requested by some of the project leaders, and one of them believes management should give them the better conditions for Visual Planning. Others think the VP-boards are not so dynamic which make them hard to use when a time plan should be shortened or extended, every note has to be moved one by one. Other drawbacks with the post-it notes is that they can fall down, and when the plan is updated for the next time period the post-it notes are removed and trashed. This make it difficult to track the progress of the project. Other thinks there is just a lot of post-its, especially when they use separate post-it notes for start of activity and end of activity, while one team member thinks they are limited by the size of the post-it note. Also, the colour code of the post-it notes needs discipline. A project leader said:

“...there is a tendency to become a lot of notes as we use both start- and end notes.”

One of the team have their VP-board at a different floor than where the most of its team members are located, which means that the team members have to walk a lot if they want to access their board. Which leads to the team members seldom look at their VP-boards between project-, risk- and short term meetings. Some of the team members are involved at several VP-boards, in different locations within the facility. The boards are of various purpose, such as: different projects, line monitoring, project planning or different parts of one project. These leads to that team members and project leaders have to make sure all VP- boards are synchronised and up to date, and that one have to make sure to know what one should do at the different boards.

6.2.3 Visual planning at two sites

Most positive and negative aspects covered above are applicable for Visual Planning at two site, however there are several addition aspects to cover when Visual Planning is used for multi-site projects.

One of the team members in Göteborg says its feel like the team members in Linköping has come closer since they started to use Visual Planning, but it is still not good enough. Another team member in Göteborg agrees that the presence does not feel as good as when the team is at one place, and one project leader thinks the commitment and efficiency is lower. Some team members in Linköping miss the opportunity to meet their team members spontaneous and to be able to see each other when needed to discuss things in the project. An interviewee think it is not the same over the phone and it is not as easy to get hold of someone over phone as if one can stroll by the others desk. The team members in Linköping prefer meetings using video rather than only using audio equipment, because it makes it easier to follow the meetings. Video makes it possible for the meeting participants to see each other. Some team members in Linköping feel that team members in Göteborg easily forget that there are participants in Linköping during the meetings if a camera is not used. As one of the interviewee in Linköping answered to the question: Do you gain what you want from the meetings?

“It has become better when we also use video communication, they are aware that we are there as well”

Sometimes the video equipment does not work, then only audio is used. There seems to be a difference in opinion between some project leaders in Göteborg and team members in Linköping. Some project leaders think communication functions well enough, as the whole team meet on a regularly basis for mid-term and long-term planning/update, which could be up to every sixth week.

The project teams are not satisfied with the audio quality and have trouble to know where to focus the camera: at the participants, at the meetings, or at the VP-board. Also the web camera does not film in wide screen which makes it hard to include the whole team in one view. During short-term meetings the camera in Göteborg is usually aimed towards the short-term plan to make it possible for the team members in Linköping to see the post-it notes. However, the team members in Linköping have trouble to read the post-its, due to too small post-it, too sloppy writing and bad pencils. The project leaders in Göteborg is aware of this issue and usually say what is written on the notes to inform the team members in Linköping, but sometimes the project leader moves forward too fast. One project leader says it works okay with the planning during the short-term meetings, but it is trickier during the project meetings when they go through the mid-term plan, as it is too big to fit within the camera. The team members in Linköping thinks it can be hard to hear what the team members in Göteborg say, especially in the beginning and end of the meetings when there is often more discussion. Both project leaders in Göteborg and the team members in Linköping think it would be good if the whole team could see the VP- boards whenever they want and to be able to and interact with them. As one team member in Linköping said:

“...it would be nice to see the mid-term plan between the meetings to be able to see the correlations between the notes.”

It is hard to use the mid-term plan when updating the short-term plan if you do not have access to the mid-term. One of the team members say that the project leader should update members in Linköping about what is next on the mid-term plan, but that the project leader often forgets and need reminders.

7 Wishes, Challenges and Possible Solutions within Emerson

This chapter presents the first analysis in the study and suggests areas of testing that should be performed at Emerson. First an analysis of the current situation at the case company is presented; what they wish to achieve and what challenges are in the way to reach those goals. This is followed by ideas for the test periods, which is based on findings within the frame of reference and the reference companies.

7.1 What Emerson wish to achieve

Visual Planning is a part of a global initiative within Emerson with the purpose to shorten led times within product development. Visual Planning is seen as a method that can support projects to be finished according to plan. The employees believe Visual Planning support this by giving a better overview, understanding and insight in the project(s). They also believe Visual Planning have helped them to do better time estimations in the projects. Other benefits of Visual Planning mentioned in interviews are that it shows correlations, simplifies overview, and visualises potential problems within the project.

For Visual Planning to fulfil the mentioned benefits three aspects have been identified as vital through the observations and interviews presented in the previous chapter, see Figure 7-1. The aspects are “see and interact with the plan”, “shared and clear instructions for Visual Planning” and “functional and useful meetings”.

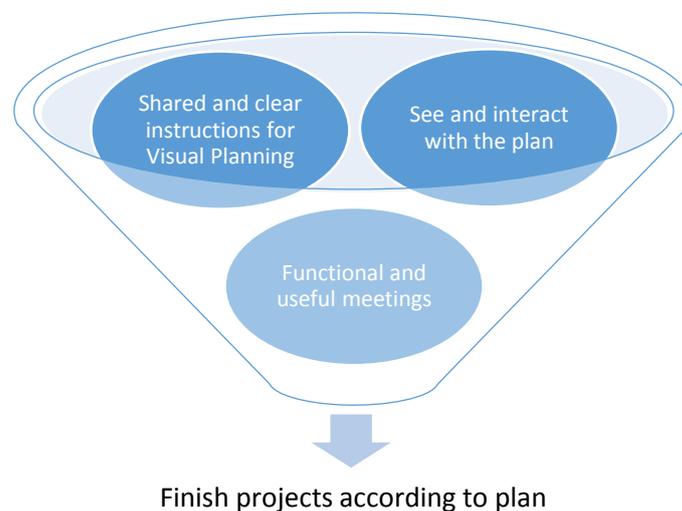


Figure 7-1: Critical aspects for Visual Planning to work successful within Emerson

7.2 Challenges along the way

Some challenges within Emerson has been identified and need to be addressed to support the critical aspects covered in previous chapter: 7.1 “What Emerson wish to achieve”. The challenges are summarised in three categories: standard and purpose, communication media and tools for Visual Planning.

7.2.1 Standard and Purpose

Some employees think a coherent view of how Emerson should use Visual Planning is missing. Visual Planning is primarily used in the projects, but some functions use it as well. Moreover, some project members and project leaders are involved in several projects and a project can have several teams depending on the size of the project. This lead to that one individual can be included at several VP-boards, and involved in a numerous different meetings, which all might use different variants of Visual Planning. It is perceived tricky to gain an overview over a larger project which consists of a couple of projects, which have their own long-term and mid-term VP-boards. This also stress the need of synchronisation between the VP-boards. It is implied that they do not trust the deadlines at their own long-term VP-board as they double-check that deadlines has not been moved at the other sub-teams long-term VP-boards. Thus, one common standard is missing, and the confidence when working with the methodology of Visual Planning varies among project leaders and project members. Therefore project leaders adapt the method in a way that make most sense to that individual. This uncertainty is also shown when using sticky notes, i.e. which level of detail should be used on the sticky notes at the long-term board compared to the mid-term and the short-term board. One of the team members also expressed that the three VP-boards feels like three different tools, and not one method; Visual Planning.

7.2.2 Communication and communication media

Communication mainly concern the following situations: within one site and between sites, and at meetings and in between meetings. Team members that work primarily on one project in Göteborg are co-located, but there are team members in Linköping that mainly work on one project that is situated in Göteborg and they are still located in Linköping. Project members that are involved in several projects are located in different offices. Co-located teams increase the opportunity to more direct communication. One of the team members in Linköping missed the opportunities to talk spontaneous with colleagues in Göteborg since it is not the easiest to get hold of people over the phone. Team members in Linköping appreciate to have a video feed between the sites during meetings. Apparently they feel that meeting participants in Göteborg easily forget them otherwise, but it is also easier to follow the meeting when there is video since one can see who talks. There has been difficulties on where to focus the camera in Göteborg, should it be aimed at the team members or the VP-board? The scope of the camera is limited and the meetings rooms are small so it is hard to fit all members of a meeting in to the view and if the camera is focused towards the VP-board it is hard to read the sticky notes over video due to their small size and people's handwriting. One project leader does not see the benefits with video feed since it is of low quality and technical issues often arise. However, as mentioned meeting participants in Linköping think it is harder to follow meetings over conference phone alone and especially when there are discussions. Also, the audio quality varies between different conference phones and the design of different rooms. For example is the call conducted through cell phone or installed phones, are doors closed to shut out extra noise during meetings and do the different rooms have enough soft material in the room to avoid echo?

7.2.3 Tool for Visual Planning

With the technology used today, sticky notes on a board, the project leader and project members have to walk to the VP-boards to be able to see and interact with them and team members in Linköping

cannot even see them. Team members in Linköping can only integrate and see the VP-boards indirectly through someone at the site in Göteborg.

The sticky note is a limit in itself since their size is small. One of the project members wanted the possibility to write both brief and detailed info on the note. A team leader miss the possibility of moving several activities at the same time as one can do in MS Project. Other drawbacks with the tool used today is that it is hard to track the progress of the project and that there is a risk that sticky notes falls down from the VP-boards.

7.3 Ideas to support Emerson with their challenges

To reach the wishes presented in **Error! Reference source not found.** the challenges in 7.2 Challenges along the way has to be addressed. Below ideas are based on the frame of reference, the reference companies and employees ideas during interviews and other informal meetings.

7.3.1 Standard and Purpose

Emerson do not have a coherent vision of how they want to use Visual Planning. The different project teams have adapt Visual Planning in a various way to fit their management style and the project and team context. Several of the reference companies have used with Visual Planning for five to ten years and have stated that it takes time to be comfortable with Visual Planning. Swan (2015) believe that a company need to evolve a certain maturity level to be successful with Visual Planning. It is therefore beneficial to create a standard and to keep it for some years and to let the organisation adapt to the method Visual Planning, and not get trapped in the implementation of different technologies and tools. This will also help the employees' request of shared and clear instructions for Visual Planning.

To make it possible for all team members at Emerson to access and interact with the VP-boards, there need to be a change of tool for Visual Planning. Mascitelli (2011) and Kaya, et al. (2014b) respectively highlight these aspects to be beneficial for the success of Visual Planning at multi-site. A change of tool will in some aspects affect the method, but there will be an aspiration to stay close to the current method to ensure stability. As the use of Visual Planning currently vary between the project teams there will be some efforts to create a common standard, but to leave some possibilities for the team to affect the layout of the VP-board as recommended by Lindlöf and Trygg (2011). Also with a new tool there are new possibilities to overlap the different time horizons since interviewees have expressed troubles with connecting the different VP-boards to each other.

From the reference companies have there been seen that it is common to update the VP-board prior to the meetings, which will be recommended for the case company to make the meetings more functional and useful. Another important aspect highlighted by Assa Abloy, Rejmes Car, Scania is the preparation of projects to create a common view and understanding among the team members, and to identify knowledge gaps. The importance of preparation is attested by Swan (2015) and Mascitelli (2011), and it will help to identify risks and knowledge gaps. If Emerson adapt this approach, the project members will hopefully not feel that they are "kidnapped" to create a long-term VP-board. This would also help the sub-teams who are perceived to have trust issues with the long-term VP-board. Lindlöf and Trygg (2012) believe the VP-board can help a team to feel they have one common true for their project.

The Emerson searches for the right level of detail on the sticky notes at the different time horizons on the VP-boards. Volvo Cars also expressed they search for the right level of details of the post-it notes,

and at UniCarriers it is the team leader who decide the right level of detail. This implies it can take time to find the right level of detail for the text at the notes, and that the team need to have a common approach. Autoliv use slightly different purpose for their VP-boards (long-term: internal and external deliveries and midterm: how to achieve them), which might make it easier to see the purpose of the different VP-boards and which level of detail the notes should have. It is therefore recommended that Emerson evolve a standard for the notes.

7.3.2 Communication and communication media

The interviewee at Ericsson highlighted the importance of the social aspects for the success of a multi-site team. There was a lot of focus for ensuring that all team members feel that they all belong to the same team regardless to where they are located. They use a video camera at their Scrum meetings and have invested in high quality audio equipment to facilitate the communication between the sites. The Scrum meetings are held in a dedicated room, designed for the purpose of distance Scrum meetings. The importance of appropriate communication media is highlighted by Duarte and Snyder (2001) and it will be considered during the test periods at Emerson to try and decrease the distance between Göteborg and Linköping and increase the feeling of visibility of the team members in Linköping. Ericsson also mentions the use of an awareness camera to increase the feeling of closeness between the team members. Törnlinde and Larsson (2002) highlights the importance of informal communication and believe awareness camera can decrease misunderstandings.

7.3.3 Tool for Visual Planning

Emerson should change from sticky notes to another tool for Visual Planning to enable that the whole team can see and interact with the VP-boards, and Duarte and Snyder (2001) believe that technology need to fit what should be performed in a multi-site team. There is also a need of improvements of the communication media to decrease the feeling of distance between the sites, but it has been covered in the chapter 7.3.2 above. Table 7-1 describe pros and cons from a Visual Planning perspective for tools currently used for planning purpose by Emerson and/or the reference companies. Table 7-1 **Error! Reference source not found.** will help to motivate which tool that will be tested at the Emerson during the test period. A general pros and con for digital tools is: it is accessible from everywhere, but one need to have a computer with internet access to reach it anywhere.

Table 7-1: Positive and negative aspects about the tools included in the study, with the perspective of Visual Planning and the VP-board for multi-site use

Tool	Comment	Pros	Cons
Excel	Open design. A digital tool.	<ul style="list-style-type: none"> - Possible to adapt - "Everyone" has it 	<ul style="list-style-type: none"> - Risk for conflicted copy - Need to release control between users
Hybrid VP-Board	One way communication: physical to digital	<ul style="list-style-type: none"> - Gives the possibility for members at a different site to see live updates 	<ul style="list-style-type: none"> - Does not support two way interaction

iObeya	Open design. Can be called: virtual smart board. A digital tool.	<ul style="list-style-type: none"> - Easy to use - Live update - Possible to adapt - Use simultaneously 	<ul style="list-style-type: none"> - Open design - No database for handling information
Magnets	Standard magnets for different deadlines/activities	<ul style="list-style-type: none"> - Gives good overview - Have a standard, which is easy to update 	<ul style="list-style-type: none"> - Difficulties when used in multi-site teams
MS Project	Is structured for Gantt scheduling. A digital tool.	<ul style="list-style-type: none"> - The activities are connected - It is very common in product development in companies 	<ul style="list-style-type: none"> - Only the project leader plans - Does not support VP methodology
Post-it's on a wall	Referred to physical planning board.	<ul style="list-style-type: none"> - Easy for single site teams - Cheap - Easy to adapt 	<ul style="list-style-type: none"> - Difficulties when used in multi-site teams - Have to go to the board to use it
Team Foundation Server (TFS)	Scrum methodology, multi-functional programme. A digital tool.	<ul style="list-style-type: none"> - Show work in progress - Possibility to store information - Live update - Use simultaneously 	<ul style="list-style-type: none"> - Does not support VP methodology
Yolean	Developed specifically for Visual Planning. A digital tool.	<ul style="list-style-type: none"> - Can see correlations - Information stored in database - Easy to learn and use - Live update - Pre-defined structure - Use simultaneously - Web-based, do not need software instalment 	<ul style="list-style-type: none"> - Hard to affect the predefined structure - Under development - Need internet connection to use software

The study focus on the method Visual Planning, with VP-boards that consist of time horizons. Therefore tools that does not support Visual Planning but rather Scrum or Gantt scheduling are rejected, TFS and MS Project Then the Visual Planning tool should support interaction for all team members, regardless of location. Based on this are sticky notes on a wall, magnets and hybrid VP-board are excluded. Excel does not support interaction from two users at the same time and only the interviewee at Assa Abloy has expressed that Excel can be used well as a Visual Planning tool and prefer the freedom it provides with its open design. Assa Abloy has a lot of experience with Visual Planning and set standards for the boards. Companies new to Visual Planning, such as Emerson, has not yet developed their own standards and therefore a structured tool is preferred. Therefore Excel is excluded as a tool for testing in this study, although it should be mentioned that an interviewee at Autoliv expressed the excellent functions for creating statistics from performed projects. Interviewees

at Volvo trucks expressed that the open design in iObeya creates many different versions in different projects and also that notes cannot be connected or traced.

Due to exclusion Yolean will be tested in this study. It is still under development at Chalmers, but the software has been developed well enough to use operatively at companies (Autoliv, Rejmes and

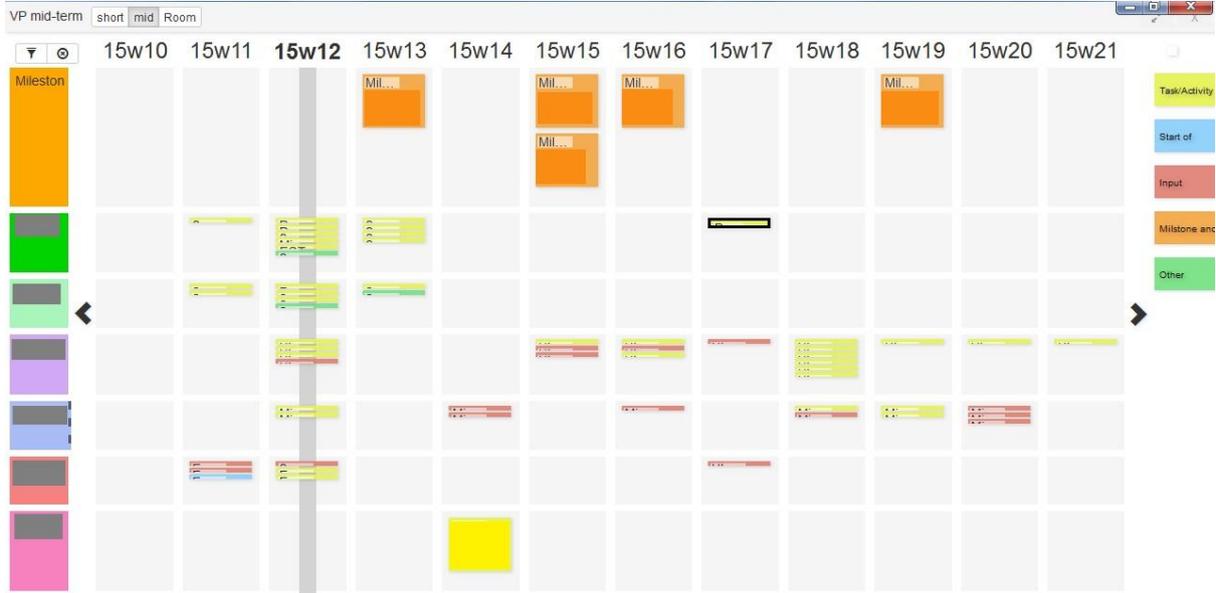


Figure 7-2: An example of a mid-term view in Yolean

Toyota). Also almost all companies has complete internet access so the risk of not being able to access the planning is very small and it is vital that the tool is “online” so that several sites can reach it. An example of Yolean can be seen in Figure 7-2.

8 Tests performed at Emerson

This chapter includes the testing performed at Emerson. The purpose of performing tests at Emerson is to address the identified challenges, chapter 7, and to support the research questions.

The tests have been performed within three teams at Emerson which all currently use sticky notes on the wall for Visual Planning, Table 8-1. In team 1 and team 2 Yolean replaced the ordinary sticky notes and functioned as an operative tool while in team 3 it has been used at separate workshops.

Table 8-1: Overview of the test period

Project team	Multi-site	Visual Planning structure	Test Period	Main Purpose
<i>Team 1</i>	No	Short-term*, mid-term and long-term VP-boards	12 weeks	Focus on a standard and purpose, communication and tool for Visual Planning
<i>Team 2</i>	Yes	Short-term, mid-term* and long-term VP-boards	5 weeks	Focus on communication media and tool for Visual Planning
<i>Team 3</i>	Yes	Mid-term (incl. 4 weeks* more detail overview) and long-term VP-boards	Shorter workshops	Focus on communication media and tool for Visual Planning

* The VP-board in focus during the tests

The choice of VP-board to focus on during the tests was made based on how the teams worked today, and where the tests could have the largest impact. The main purpose for the tests in team 1 was to focus on creating a standard, clarify the purpose of the VP-boards and the meetings, communication and Yolean. For team 2 and team 3 have focus been on communication media and Yolean, where one difference where that team 2 used a video camera. Team 3 had members at three different sites and team 2 only two sites.

The version of Yolean tested includes the following features: possibility to connect notes to each other (by the use of the same headline), possibility to mark the note with a star, a frame and/or a cross to show its status and the possibilities to mark which lanes one wish to see. The time horizons used in Yolean during the tests are similar to the short-term and mid-term horizons currently used by Emerson: 2 weeks with the weekdays displayed and 12 weeks. It is possible to zoom either in a horizontal lane or in a vertical lane.

8.1 Changes tested

The test period was structured in PDCA-cycle, which meant continuous changes were made to the tests based on the result of previous tests. There was also a purpose not to change too much between the meetings to make it possible for the team members to get used to the new way of working, and

to facilitate for a common standard. Table 8-2Table 8-2 display which changes that have been tested in the different teams with a short motivation, and as previously mentioned Yolean was tested in all teams.

Table 8-2: Overview of the changes that have been tested

What	Why	Project team	Focus
<i>New room and changes in the layout of the room⁶</i>	To facilitate for the participants to see and interact with the VP-board in Yolean and to improve the communication within the team	Team 1 and team 2	Communication
<i>Written instructions for the meetings</i>	To create a common and shared standard	Team 1	Standard
<i>Use of a timer</i>	To keep the meetings within 15 minutes	Team 1	Standard
<i>Update the VP-board prior to the meetings</i>	To avoid up-date of the VP-board at the meetings which takes time, and to motivate the participants to think through prior to the meeting	Team 1	Standard
<i>Mark in the floor where to stand</i>	To get the meetings participants to stand closer to each other and if camera is used to be seen in it	Team 1 and team 2	Communication
<i>Stand-up meeting</i>	To create a sense of urgency	Team 2	Communication
<i>Sit-down meeting</i>	For comparison to stand-up meetings	Team 1	Communication
<i>Inform team members prior to the meeting about its purpose</i>	To facilitate a common understanding of what should be the outcome of the meeting	Team 1	Purpose
<i>Short-term and mid-term view in the same VP-board</i>	To always have access to the information from the mid-term VP-board when looking at the short-term VP-board	Team 1	Tool for Visual Planning
<i>Bigger screen for the web-camera and use of wide-angle camera</i>	To facilitate the interaction between sites. Everyone can see each other.	Team 2	Communication media
<i>Include a calendar</i>	To make it possible for the participants to see which weeks belong to which month	Team 1 and team 2	Standard

⁶ Focus in the project has been at the facilities within Göteborg and the participants in Linköping have been in rooms with access to corresponding equipment

<i>Change audio equipment</i>	To try to gain better audio quality to facilitate the communication between the sites	Team 2 and team 3	Communication media
<i>Test different correlations of the notes</i>	Find which correlations that should be connected to each other	Team 1 and team 2	Tool for Visual Planning
<i>Test different screens</i>	Test how big screen and high resolution is needed for Yolean	Team 1 and team 2	Communication media

8.2 Findings

The findings from the test periods have been categorised within Method: Standard and Purpose, Meeting room and communication media, and Results and experienced opinions about Yolean. These categories relates to the ones used in the previous chapter “Wishes, Challenges and Possible Solutions within Emerson”.

8.2.1 Method: Standard and Purpose

In question for team 1 was the method, the creation of a standard and clarification of the purpose. Testing was mostly performed at their short-term meetings that were held once a week as they were in a low-intensive phase of the project.

During the test period the short-term window of two weeks within Yolean was abandoned in favour of a mid-term view that displayed three weeks. It was easy to get lost in the weeks when only seeing two weeks and employees felt it unnecessary to plan on a day-to-day level when meetings only were held once a week. Therefore a zoomed in mid-term view was used, which displayed three weeks but not the individual days. The meeting participants agreed that it gave a better overview.

There has been an aspiration to stay close the current method used at the company, but to adjust it to Yolean and to introduce some improvements. During the first meetings with team 1 the instructions were: *“Perform the meeting as usual, it is just the tool that has changed not the method”*. However, the meetings participants requested written rules for the meeting and how notes in Yolean should be addressed. The instructions in combination to the meeting participants being more comfortable with the new tool made the discussions evolve. Instead of being about the tool the team started discussing the methodology Visual Planning. There have been discussions about what the different colours of the notes represent, what the difference is between an activity and a deadline, how risks should be handled and how the communication and coordination between other teams and stakeholders should work. The standard colours have been the same as the one used for their physical VP-boards, where a yellow sticky note represent both an activity and a delivery.

Due to Yolean itself having a standard, uncertainties in how the team used Visual Planning was revealed. These uncertainties were not new, but they were not visualised before when they used sticky notes because everyone could use it slightly different without it been highlighted. For example when a note was almost finished it could be removed from the VP-board to give room for next week’s planning, but in Yolean nothing is removed and one is not allowed to cross a note until it is finished completely. At the meetings during the test period, the team leader and the team members presents their lanes one by one. They mark/highlight the current note they are talking about which makes it

possible for everyone to read it. Previously, it was not clear if everyone could read what was written on the sticky notes, even if they were at the same site due to bad hand writing.

The risk-aspects and the communication and coordination between the teams are aspects outside the span of this study and have therefore not been addressed or changed from when the tests were introduced. Nevertheless, these questions have been raised during the test period and accentuate the need of a common standard within Emerson, and that there need to be a clear purpose of each type of meeting.

To facilitate the creation of a standard for Visual Planning within Emerson some rules have been presented to steer meetings in addition to that each team member should update his or hers lane on the VP-board prior to meetings, Table 8-3. To further support the meetings, and to keep them within 15 minutes and with the right level of detail, a timer has been introduced. Before the timer there was a tendency that the first few meeting participants talked too much and gave too detailed information, which led to the last persons having very limited time to share what they were working on.

Table 8-3: Rules for meetings in team 1

- activities that is before today's dates should be moved forward in time or marked as completed (similar to how it was before) and
- activities marked with a star should be free from a star after a team member has presented his or hers lane. (the star was used to display new notes on the board that had yet to be presented to the rest of the team)

To try and create a clearer connection between the mid-term and short-term boards Team 1 has had both of them displayed in the same VP-board in Yolean. It was appreciated to have the possibility to see a longer time period than just the short-term plan (i.e. two weeks) and it improved the correlation between the two plans. However, the team members had troubles with distinguish between mid-term and short-term notes. Therefore there has been discussions about how to distinguish these two plans from each-other. Usually the consequence of moving forward a short-term note is not as big as moving a mid-term note since the activities are smaller and are not connected to other tasks as they are in the mid-term. There seem to be no simple and satisfying solution in the current version of Yolean so the conclusion has been not to have mid-term and short-term in the same VP-board, but to keep them apart as one have them with sticky notes on a wall.

Within Yolean the time horizons are predefined, and a consequence is that the user have to adapt to its layout, which can help a company to create a common standard for Visual Planning. However, dates are not visible in Yolean, which only display days and weeks, and this is something teams have missed. Therefore a table of months correlated to the weeks have been taped to the wall in the meeting room. The coloured notes in Yolean is also pre-defined according to Emerson's standard and it is not possible to introduce new colours in Yolean as it is to buy new sticky notes. There has also been discussions concerning which notes that should be connected to each other: start-of-activity and end-of-activity, common areas, or the product component. By connecting a note in Yolean the other note(s) highlights when one of those notes are marked, e.g. B21 is connected to B21, but not to B20. The other notes fade into the background.

The change of tool has made it possible for everyone in the team to always have access to the VP-board, and update it without having to move to the physical location. There was also a tendency at first to include more details than usual on the notes in Yolean, since the notes in Yolean does not have

the same size constraint as a sticky note. It led to meetings becoming too detailed, but the team reflected upon this by themselves and then reduced the amount of information on the notes and it stopped being an issue.

Some teams within Emerson have highlighted that they double check their mid-term board to make sure they are synchronised with other team's long-terms and mid-terms. This is especially true for teams that work on sub-projects within a larger project. Suggestions have been to add all sub-teams in the project to the same VP-board and use the sorting function in Yolean. It would have needed larger, more extensive, tests and the user interface of Yolean was perceived to not to be well enough adapted for the intensity so the idea was delimited.

8.2.2 Meeting room and communication media

To support digital meetings a new room design was introduced and in multi-site meetings additional changes were done. In team 1 all team members are located in Göteborg, and the focus was to efficiently use Yolean and have a good flow during short-term meetings. There was no access to a large TV-screen during the tests and therefore a projector screen (~80 inches) was used instead and the rest of the design can be seen in, Figure 8-1. A high table has been included with mouse and keyboard to master the screen. Instead of meeting participants moving to the VP-board to give an update on their respective lane they moved to the keyboard and mouse.



Figure 8-1: Meeting room for team 1

The rooms used for Yolean in team 1 were larger than previous meeting rooms and it led to team members spreading out along the walls. It caused the meeting to lose urgency and team members lost focus and started discussing in smaller groups. To prevent this, a box was marked on the floor where team members had to stand within.

Team 1 has in addition to the room in Figure 8-1 above, used two other rooms where meetings were performed sitting down. One of those rooms where a computer screen (around 20 inches) was used and in the other one was a TV-screen (~42 inches) used. The computer screen was perceived as too small, while the TV-screen worked fine. However, some of the team members said they preferred the big projector screen. The majority of the meeting participants preferred to have meetings standing up and one said,

“.. believe it is better to stand-up during short meetings. Have a feeling that if you stand the meeting will be more efficient.”

One of the meeting participants preferred to sit, especially if meetings are longer. One team member believed focus on the VP-board diminishes when the meeting is held sitting down, and that it was worse in an ergonomic aspect since one had to turn the head to see the screen. They had to move the mouse between each other to control the VP-board and it was difficult to move the keyboard to make it possible to add a note during the meeting. An observed difference was that the one managing the VP-board was not in charge in the same way as at a stand-up meeting and was sometimes interrupted. At a stand-up meeting it is clearer that it is the person controlling the VP-board, i.e. the computer, who should speak and therefore a speaker's corner has been defined as necessary, see the red ring in Figure 8-2.

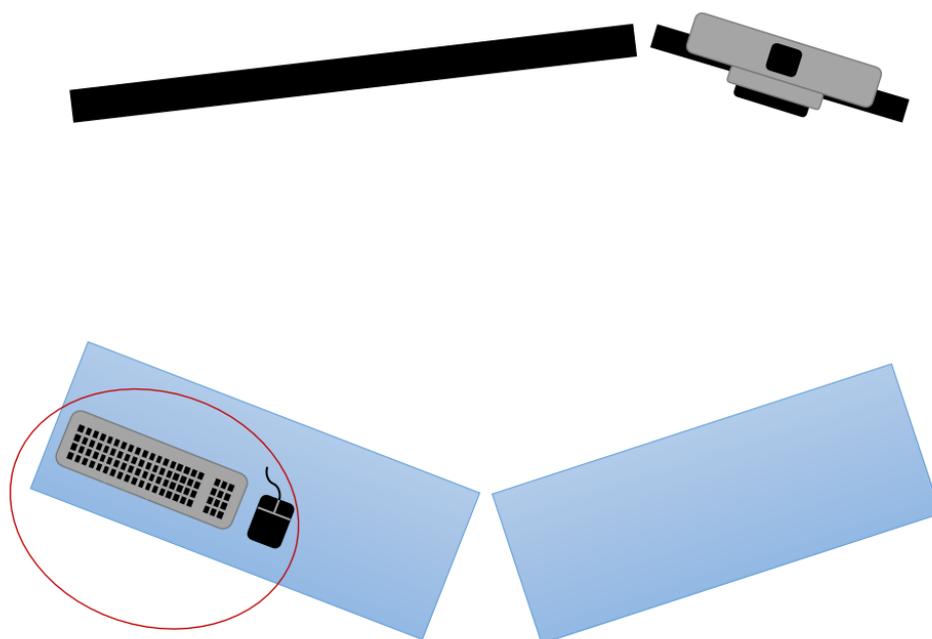


Figure 8-2: The speaker's corner at the stand-up meetings, marked with a red circle

The standard room in Göteborg that the team use for multi-site meetings was not satisfactory so another room was used during tests. Also the old room had bad acoustics and a lot of sound came in from the corridor outside. The new room, Figure 8-3, was equipped with better audio and video equipment and with access to two screens, the bigger for Yolean and the smaller for the video feed. The camera had a wider angle than the camera equipment used earlier which made it possible to fit the whole team within the camera angle. The video was shown at a separate screen, which also contributed to the feeling that the team members in Linköping felt closer for the participants in Göteborg. This was also appreciated by the team members in Linköping, which also thought the audio was better than usual. This team usually sits during their meeting, but to facilitate their focus and interaction with the other site the first test was performed standing-up. However, the meeting was 45 minutes long and the participants seemed to lose focus after 25 minutes and started to shift their standing positions. There was also only one stand-up table which made it hard for the participants to take notes. One of the participants in Göteborg expressed that it felt like the members in Göteborg stood on a long row and it did not feel natural.



Figure 8-3: The new meeting room for team 2. The left picture is from the first test. The latter two were performed sitting down as can be seen in the right picture.

The following meetings were performed sitting down, and the chairs were directed towards the camera to facilitate the interaction between the sites, Figure 8-3. The meeting participants in Göteborg felt more comfortable with this arrangement and one participant in Linköping said it did not matter if the members in Göteborg were standing or sitting down. The difference between the meeting structure in team 1 and 2 is that team 1 focus on 15 minutes short-term meetings and team 2 handle mid-term project planning that include more discussions.

Another difference between the meetings within team 2 compared to team 1 is that the team leader have a clearer leadership role at these meetings. The team leader leads the meeting and is in charge over the mouse and keyboard during the entire meeting. The meeting participants in Linköping have access to a mirrored screen to see what is currently discussed. Team 1 use Yolean for their short-term planning and during these meetings are the focus more on what the individuals in the team have done and will do. The team members individually update their lanes by having control over the mouse and keyboard. The team leader for team 2 also need to have good knowledge of the functionality within Yolean as it is the only one using it during the meeting unlike in team 1 where it is possible for the team members to remind each other about tricks in Yolean.

The meeting participants in both Göteborg and Linköping thought it felt like the team members in Linköping where more present at the meeting and that it was good to use a camera where everyone was included in the frame. One team member in Göteborg said,

“Good video and audio gives a better sense of community”

The meeting participants in Linköping appreciated that Yolean and the video feed was presented on different screens, Figure 8-4. They had Yolean on a projector screen, which they believed worked well and is something they recommend for meetings in Göteborg as well. They also think they saw the team members in Göteborg better and that the audio was better than usual, but it could still be hard to hear everything that was said in Göteborg.

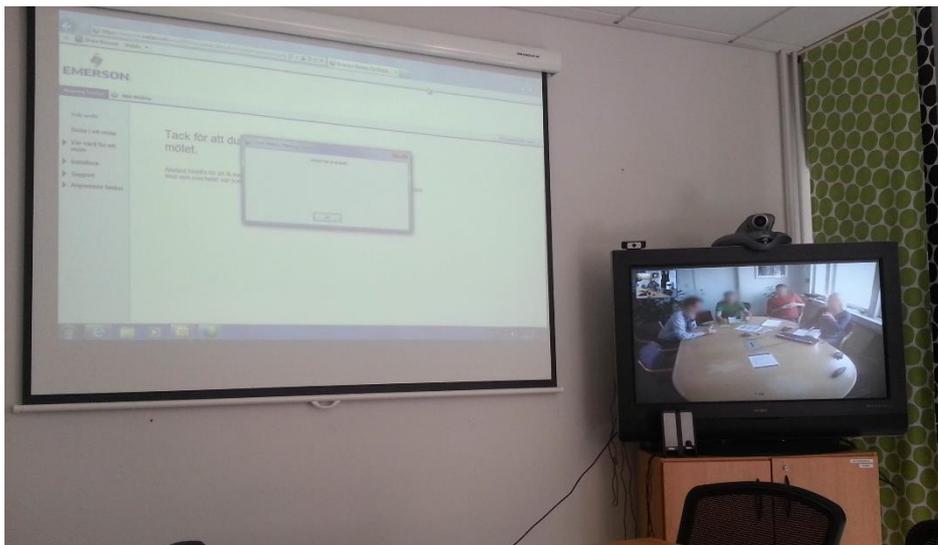


Figure 8-4: The meeting room for team members in Linköping

Within team 3 Yolean was tested during a workshop. This team does not use video camera, due to its members are spread out over three different locations; Göteborg, Linköping and Jönköping. During the workshop a smaller part of the team was present with representatives from Göteborg and Linköping. At regular meetings there are up to 15 participants from Göteborg, Linköping and Jönköping. From observations it has been clear that it is easier to include the whole team if a video feed is used, team 2, as it is possible to see each other and to talk to each other rather than just “to” a conference phone. When only audio is used there is an uncertainty present to if “those on the other side” are actually present.

There has been some comments from team members that Visual Planning could replace some communication. For example, if input notes are used on the board do I have to also tell someone that I want something? After discussions it was clear that a note cannot replace talking to someone since they may miss the note or not fully understand what it means and maybe they cannot deliver the input on the requested time. Also, with the use of Yolean a dot on the note is automatically added when it is being moved forward. Do the team member then have to inform the rest of the team about the delay since everyone can see the dots, do the person even have to be at the meeting? A team leader answered that he or she cannot know what consequence a delayed activity will have and therefore everyone have to keep communicating. The last two examples prove that the digital tool chosen to express the boards in Visual Planning cannot and should not replace communication.

As evaluation at tests team members were offered to write positive and negative feedback on sticky notes. The notes were collected by the researchers and solutions were found to solve the negative ones. The method was very simple and should be kept, but instead of the researchers finding solutions the team leader should collect the notes.

8.2.3 Results and experienced opinions about Yolean

Yolean enables everyone within the team to see and interact with the planning, regardless of site. It is possible for entire teams to use it at the same time, and it will not be delays or conflicted copies. It is easier for the team leader and the team members to update the VP-board prior to the meetings as

they do not have to go to its physical location. This was especially appreciated by team members whose offices were on different floors from the physical VP-boards.

When Yolean was first introduced the team members were curious about what the tool could do, and they easily adapted to it. The users have had access to a manual of how-to for Yolean, which have been custom made for Emerson to fit their standard of colours. In team 1 all meeting participants used the keyboard and mouse during the meetings and they estimated that they had used the tool between five and fifteen minutes prior to the first meeting where Yolean was used. This time estimation included a short demonstration of Yolean by the researchers. The feedback from this test occasion was generally positive with comments such as: nice, neat and clear, gives good overview and do not have to write sticky notes. Some drawbacks considered mentioned were: small bugs in the software, lack of a calendar overview and it takes longer to write a note. The small bugs have been accepted within the group as Yolean is under development, and the lack of calendar was later addressed by bringing a calendar that displayed months and weeks correlations to the meetings. To overcome the time it takes to write notes, the standard has changed from writing notes at the meeting to, write the notes ahead. The feedback from the users after the second meeting was that they had better knowledge about Yolean and they felt the meeting worked well with Yolean. However, as previously mentioned the team started adding more to the notes but it was noticed by themselves and discussed and then it was no longer an issue. After the first meetings with Yolean the excitement about the tool decreased and the meetings were treated as “normal meetings”. However, discussions arose about the method which have been covered in chapter 8.2.1 “Method: Standard and Purpose”.

Most meeting participants within team 2 had not yet seen Yolean prior to the first meeting where it was used, but they seemed to easily understand what happened on the screen. As previously mentioned these meetings is led by the team leader who controls Yolean for their Visual Planning and Excel for other project related activities. Linköping have access to Excel and Yolean over a “shared desktop”. Some team members expressed that it felt confusing when the team leaders changed back and forth between the windows on the screen, and some wrote “motion sickness” or that there was a need of a third screen (in the test one large screen was used for Yolean and Excel and one smaller for the video feed with Linköping). To solve the critique the structure was slightly changed to the next test, where the team could work more within either Yolean or Excel, and thereby avoiding “motion sickness”. However, some meetings participants in Göteborg have expressed that the screen used is too small for the screen, and have too low resolution. The screen used is 42 inches and is not full HD.

The meeting participants in Linköping have a lot easier to follow the meetings when they can see the VP-boards: what is written on the notes and how they correlate to each other. For the meeting participants in Göteborg is it also easier to read what is written on the notes and to see which notes that correlate to each other. They do not have to stand as close to the VP-board to be able to reading and search for which notes that correlates, and do not risk ending up with their backs against the others in the team. However, there can be a risk that the one using the keyboard and mouse end up directing the screen with Yolean instead of the team, but by placing the mouse and keyboard strategically this risk is limited. The meetings participants also feel more comfortable when facing each other; team 1 made sure to talk to the team and one in team 2 felt uncomfortable when standing on a line, by having meeting rooms of better size curving the line should be possible.

9 Analysis and Discussion

This chapter analyse and discuss the research sub-questions, the results generalisability and future research. The study's two sub-questions are analysed and discussed in chapter 9.1 and chapter 9.2 respectively. It is based on the results gathered from the frame of reference, the reference companies, and the case company, i.e. Emerson. Results from Emerson are mainly results from the testing period, but also input from the interviews and observations. The overall research question is answered in chapter 10: Conclusion.

9.1 How can Visual Planning help a team to succeed?

Much of the research within the field focus on the benefits of Visual Planning, but the results are fewer within the aspects of how to implement and use Visual Planning to gain these strengths. This study contributes to those aspects.

Visual Planning can help a team to identify risks early, but the team need to use it to their advantage, i.e. work proactively with the risks and not only identify them. It takes time for a company to fully adapt to Visual Planning, since competence concerning the method is needed. Knowledge about Visual Planning is either gained within the organisation through using it over a longer period of time or by bringing in persons to the organisation that have it. A company that recently adapted Visual Planning need to have patience, and to remember that there is no universal way that fits everyone.

To make employees comfortable with Visual Planning, a clear purpose of Visual Planning in the organisation is needed, but also to be able to create a company standard for Visual Planning that will be useful. Otherwise the risk will be that even if the employees understand why the company use Visual Planning they will not know how to gain the benefits. It can also lead to frustration within the teams that they have to spend time and focus on how to use the tools in Visual Planning instead of continue with the tasks in the project.

Shani et al (2009) describe six factors which are believed to affect the evolution of a team. All of the factors have been observed in the study except **composition and diversity** since it falls outside the

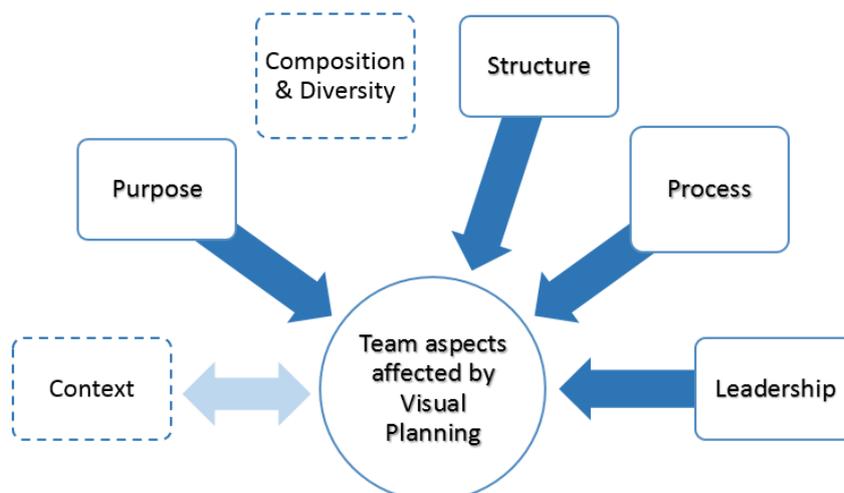


Figure 9-1: The six team aspects which affect team performance according to Shani et al (2009) have been adapted to show how they relate to Visual Planning. Context is both affected by Visual Planning and can affect the outcome of Visual Planning.

scope of the study. The others **context, purpose, process, structure** and **leadership** are all interlinked with Visual Planning, Figure 9-1.

During the test period performed at Emerson changes in **purpose, process, structure** and **leadership** was observed, Figure 9-2. **Context** is both affected by Visual Planning and can affect how a team can succeed with Visual Planning, its connection to Visual Planning has been confirmed through the frame of reference and the empirical findings. The context at a company affect teams' performance and includes the company culture (Shani, et al., 2009). The company culture can be changed over time with the help of Visual Planning. Swan (2015) mentions changes in behaviour at the company to be one of large benefits with Visual Planning and this study confirms that. During interviews at Emerson several employees said that communication and the feeling of involvement had improved since they had started with Visual Planning.

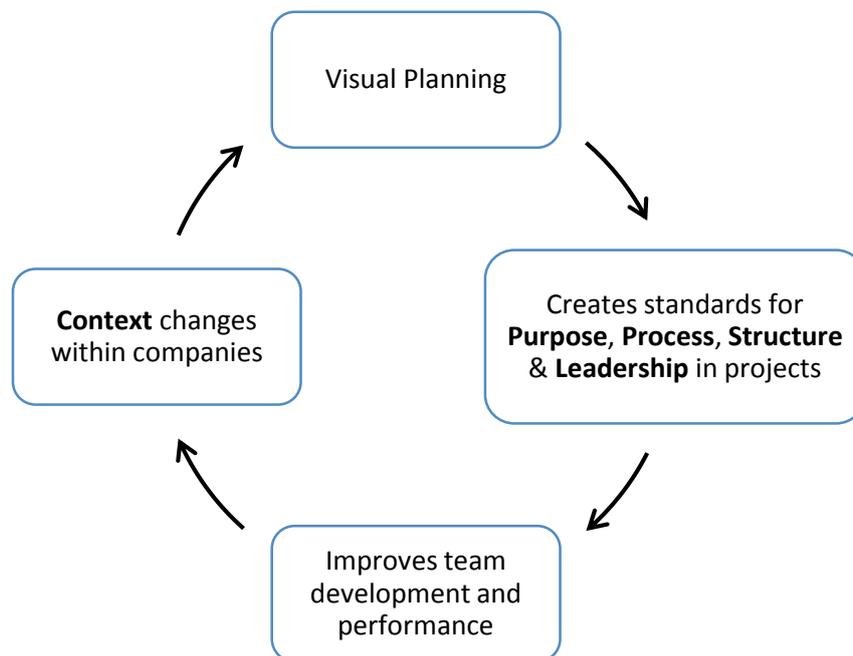


Figure 9-2: How Visual Planning affect a company based on results gathered in the study

The teams involved in the test period requested a clear **purpose** of the meetings, and the importance of a defined goal have been highlighted by both Katzenbach and Smith (2006) and some of the reference companies. The interviewee at Assa Abloy stressed the importance of working towards clear goals and that the project team should have a common view of what should be achieved. Katzenbach and Smith (2006) emphasise the need of a common commitment within the team.

The informal roles within the teams also evolved during the test period. Had it not been for one team member taking responsibility to stay close to the method, the method would have fallen after a couple of weeks and with it the performance of the meeting. When the team started to use YoLean at their short-term meetings, they gained more structure which suited this team member well, and made it possible for this team member to take a task oriented role within the team. Therefore the **structure** of the team, which includes team members' informal roles and the teams work design (Shani, et al., 2009), has evolved due to the use of Visual Planning.

The communication **process** has been discussed during the test period, and uncertainties have taken both time, focus and energy from the team, but hopefully the group has improved due to the talks.

Visual Planning creates, affects and supports **processes** through the structured meetings and the VP-boards. This is especially helpful within multi-site teams since often the different sites does not communicate much in between meetings. Visual Planning will support the team with structured communication processes and can help to visualise the correlations within a team. This strength the statement by Shani et al (2009) that structure and processes within a team plays an important role for the success of a team.

The sixth aspect highlighted by Shani et al (2009) considers the **leadership**. The interviewee at Ericsson did not want to identify oneself as the team leader since everyone within the team should feel responsible, while the interviewee at Scania believe the leadership is crucial during meetings using the VP-boards. The interviewee at Scania argued that a clear leader during the short-term meetings can help the team members to understand what is expected of them. Also, when employees are given the chance to control their goal they will take more personal responsibility for reaching it (Pierce, et al., 2001). Assa Abloy highlight that a team should know their status rather than work against detailed deadlines. Visual Planning can support the leader to make the goals, expectations and roles clear as it is the team members that perform their own planning and it makes it possible for the team members by themselves to see their dependencies between each other. The leader can also gain support from Visual Planning within a multi-site team as Visual Planning creates a structure on communication which gives the team and team leader a lowest limit on how to communicate between sites. These reasoning strengthen the importance of leadership for a team to succeed.

9.1.1 When to use Visual Planning in a team

Within the field of research many strength with Visual Planning have been identified. Söderberg and Alfredson (2011) believe Visual Planning support complex product development, which is the reality for many companies today. There has to be a need of Visual Planning otherwise the method will feel redundant and will not support a team to succeed. If there is a need of coordination or/and collaboration in an organisation Visual Planning is a good solution, Figure 9-3.

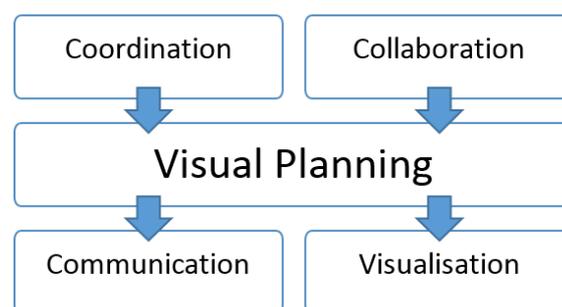


Figure 9-3: If there is a need of coordination and collaboration Visual Planning can support through structured processes for communication and visualisation

Lindlöf and Söderberg (2011) highlights that Visual Planning can support communication and coordination within the team, but adds there need to be something to coordinate, i.e. a common project or assignments. This is strengthen by both Emerson and the reference companies. It can be connected to the desire to focus on relevant information at the short-term meetings, and if the team does not have something to coordinate the information will not fell relevant for the meeting participants. Emerson believed the communication within the teams has improved a lot since they implemented Visual Planning, and highlight that one great advantages with Visual Planning is that it

shows correlations and dependencies. This help the project members to understand what and when others are dependent on them, and vice versa. This is a key with Visual Planning, it facilitate planning within the team, and not just the project leader (Swan, 2015) and Mascitelli (2011) highlights that Visual Planning is interactive. Holmdahl (2010) believes Visual Planning give increased flexibility, better control and managing of the organisation, less dealys and reduced work as it is possible to see synergies. Visual Planning will therefore be helpful if a team is of need of coordination and/or communication.

9.1.2 The meetings and the VP-boards

The meeting that gets the most focus in this field of research is the stand-up short-term meeting, usually 15 minutes long. However, most reference companies and the case company use different workshops/meetings for different purpose, i.e. long-term, mid-term and short term planning. One benefit with having different meetings with different purpose is to limit the risk of just focusing on the following days and weeks and lose the mid-term and long-term perspective. However, there can be difficulties to synchronise the different VP-boards if one not have a common standard on how it should be done and a risk of having parallel boards. It could therefore be beneficial to use two VP-boards instead of three which Swan (2015) recommends. However, one of the team had during the test period their short-term and mid-term view within the same board in Yolean but it raised uncertainty of which notes that belong to the short-term plan and which belong to the mid-term board. This led to notes at the mid-term board were moved without reacting on how it might affect the long-term board. It is therefore recommended to use three time horizons but to clearly distinguish the purpose between them. The long-term VP-board should consists of gates, milestones and deliveries, which should not be delayed and should be agreements within the team. The mid-term VP-board should show how the team should reach the gates, milestones and deliveries at the long-term VP-board, while the short-term VP-board describes how the notes at the mid-term board should be achieved on a daily basis.

The VP-boards represent a snap-shoot of planning, i.e. the plan, and the short-term and mid-term VP-boards need to be up-dated continuously to support the team and to work as a planning. The VP-board should help the team to gain an overview of their planning, and it can have different layouts and colours to support this. Emerson use start of activity to help the users to see when an activity should start, Rejmes Cars use connections within YoLean and Scania use standard magnets to display which activities that correlates. It is also common within the reference companies to use input-notes, and companies mark critical deliveries to make them visible.

The premises for the meetings should support Visual Planning, in the same way as the Visual Planning tool should facilitate for Visual Planning. The premises can facilitate the communication within the team. Table 9-1, Table 9-2 and Table 9-3 shows a number of aspects that can support a team to succeed Visual Planning, which will help them to gain the desired benefits of Visual Planning.

Table 9-1: Aspects concerning meetings that can help a company to succeed with Visual Planning (from the frame of reference and/or the reference companies)

- Clear purpose of the different meetings
- Use facilities that support Visual Planning
- The meetings interval for the short-term meetings should be decided upon the need of communication (Lindlöf & Söderberg, 2011)

- Have the short-term meetings in the morning or before lunch to gain benefits from them the same day (Masciotti, 2007)

Swan (2015) and Masciotti (2011) discuss the frequency of the meetings, and Swan (2015) argue that one risk of having too long meeting intervals is that decisions are taken in a parallel process. Swan (2015) recommend to have meetings twice as often as the finest detailed level at the short-term VP-board. One of the team was in a low intensive phase of their project and had short-term meetings once a week. Before and in the beginning of the test period they used a resolution of their short-term VP-board that displayed every weekday but they felt it was unnecessary detailed to plan on individual days. Therefore another resolution was used which displayed whole weeks. If the communication and decisions are taken outside the meetings, will the purpose and the relevance of the meeting be less.

Table 9-2: Aspects at the short-term meetings that can help a company to succeed with Visual Planning (from the frame of reference and/or the reference companies)

- Look ahead, do not get trapped in yesterday
- Use standard questions at the short-term meetings (Masciotti, 2007)
 - o Focus on what is left to be done, to be able to deliver, and if there are any risks
- Use a timer to keep track of each individual's time slot, to not have time to start discussions (Lindlöf & Söderberg, 2011)
- Use stand-up meetings
- Make sure the team members have some un-booked time after the meeting to make it possible to take discussions after the meeting, and not at the meeting where it is not relevant for everyone
- Mark at the floor where the meetings participants should stand to increase the interaction

The tips in Table 9-2 aim to support short, brief, open and relevant meetings. The importance of short meetings have been emphasised by the project members at Emerson. Both stand-up meetings and sit-down meetings have been tried used during the test period. Where the purpose of the meeting where to have a brief short-term meeting, a stand-up meeting was a much better format and the meeting participants felt the meetings are more efficient when they stand. However, for the test team that used YoLean at their mid-term-meetings where the meeting where longer and more of a discussion character, it worked well to sit-down. The meetings where the team sat took the team leader a more leading role and the meeting participants where more likely to interrupt each other. Timer and markings in the floor where used during the test period and it help the team to keep their meeting on time and to stay focus.

Table 9-3: Aspects concerning the VP-boards that can help a company to succeed with Visual Planning (from the reference companies)

- Clear purpose of the VP-boards
- Update the VP-board prior to the meeting to facilitate short meetings
- Use standard coloured notes, and standard layout for the VP-boards

The test period shown the importance of having a clear purpose of the meetings and the VP-board, both in the aspect of why to have but also how to use them. The team leaders and team members at Emerson wish there was a standard way they should use Visual Planning. However, Lindlöf and Trygg (2011) argue that the team should be able to affect their layout of the board. Masciotti (2011) talked about ownership and that if the team creates the plan there is a greater feeling of ownership from them and it is more likely that the project will finish on time. It has been identified that the employees

want to know how they should use it, and all reference companies involved in the study have some standard VP-board they use. However, it can be positive if the team can affect the intervals and length (maximum 15 minutes) for meetings and how the information should be expressed at the notes (detail, connection between the notes and so on).

9.1.3 Visual Planning is more than the meetings and the VP-boards

The field of research focus primary on the short-term meetings and the VP-boards, however there are more aspects that need consideration to be able to succeed with Visual Planning.

Swan (2015) believes the purpose with Visual Planning is to change behaviour. He argues this to be the challenge with Visual Planning, to change the company culture, rather than the technical aspects, which is too easy to focus on. Visual Planning can help a team to succeed, however it is just a mean not a universal solution and the team aspects discussed earlier within this chapter is significant for the success. It is also important to remember that it takes a lot of work and time to change behaviour and company culture.

The test period shown that the method for Visual Planning and the social aspects within Visual Planning have great impact for if a team will succeed with Visual Planning. Technical aspects also contributes to the success, however it rather sets the pre-conditions for Visual Planning and is just a mean to reach the desired benefits of Visual Planning. However, the poor technical aspects can affect the outcome of Visual Planning. Technical aspects have mainly focused on the tool used for Visual Planning, in this case Yolean. The pre-defined structure within Yolean contributed to the knowledge gaps within the teams about Visual Planning where identified and it also supported the team to adapt to a common standard which support the method for Visual Planning.

Prior to a long-term plan is created there need to be some preparation within the team. Emerson has identified that they were weak at this in the beginning which made it hard to create reliable long-term plans. Both the interviewee at Assa Abloy and within Scania believe they can handle 20 % uncertainties within a project, and is the uncertainty higher it needs to be addressed prior to the planning is done. By doing a proper preparation for projects, it is possible to identify knowledge gaps and to give the team a common understating of the task which will help the team in the long run.

Within the framework Scrum sprints reviews are included between the sprints, and the team at Ericsson also had a retro occasion. These elements give the team a chance to reflect, to give each other feedback and to learn to be better to the next sprint. During the test period the teams had the opportunity to give positive and/or negative feedback at sticky notes at the end of the meetings. This gave the researchers the possibility to address aspects highlighted by the team but it also gave the team a chance to reflect. It is believed that these minor evaluations where beneficial and is something that is recommended to include within Visual Planning in a regular basis.

The study has also identified the importance of a method owner for Visual Planning, to support the development of a company standard and to give the team and team leaders the support they need with the implementation of Visual Planning. The method owner should have good knowledge within Visual Planning. Swan (2015) argues that a team cannot blame the tool if the plan is of low quality, since the tool is only a tool and it only reflects the ability of the users.

9.2 How can differences between single-site teams and multi-site teams be addressed?

Multi-site teams do not gain anything for free such as asking simple questions when walking by someone's office or the ability to read body language since many meetings are over the phone. Instead there has to be equipment to support communication and interaction, i.e. communication media. Duarte and Snyder (2001) talk about the importance of leadership that support multi-site teams and reference companies have highlighted the importance of a structured leader to have good meetings, and it is even more relevant at multi-site meetings according to the interviewee at Volvo Trucks. References within the field of multi-site teams highlights some important aspect that need to be considered for a multi-site team, Table 9-4. These aspects strengthen that a multi-site team do not gain anything for free and the team need to focus on these aspects to succeed. Ericson also highlighted the importance of a kick-off and to meet each other face-to-face prior to one work together.

Table 9-4: Aspects that help a company to succeed with multi-site teams (from the Frame of Reference)

- The virtual team should meet face-to-face prior to they start working together (Hertel et al, 2005), and have a common kick-off with the virtual team where the team members meet, which at least includes the following aspects (Duarte & Snyder, 2001):
 - an introduction and overview of the team's task,
 - development of guidelines (norms) for the team,
 - plans for the use of technologies and communication, and
 - team building.
- Maintain the team climate during the project and focus on (Hertel et al, 2005):
 - leadership,
 - communication within the virtual team,
 - the motivation of the virtual team members, and
 - knowledge management.
- Focus on team awareness and feedback to the individuals, acknowledge achievements and clarified goals and team roles (Hertel et al, 2005)

A company need to choose between one team at several locations or several sub-teams at the respective locations. Sub-teams can work if functions in projects are clearly divided between sites so team leaders of sub-teams can report input to a common project leader and other sub-teams. Sub-teams can use a common long-term VP-board and have individual mid/short-term VP-boards as Swan (2015) described. If there is need for collaboration and not only input between sites a multi-site team is necessary. Some reference companies have highlighted the importance of including everyone in teams, but the needed effort to achieve this increase in multi-site teams. Ericsson work as one team over two sites and focus a lot on the informal social aspects. For example, the team members should always say "hi" and "bye" when arriving in the morning and when leaving at the end of the day. They also use informal communication areas such as Facebook groups and chat forums, and have discussed the used of an awareness camera, the latter supported by Törnlin and Larsson (2012). Hertel et al (2005) agree, as they argue for the importance to facilitate non-job-related communication to increase the feelings of belongingness and trust. This study recommend a multi-site team to focus in these aspects, as they will not gain them for free at coffee breaks for instance.

Ericsson highlighted the importance of good audio sound to support the communication between the facilities, and that video equipment facilitates this even more. Duarte and Snyder (2001) discuss the importance to match the communication media with the type of collaboration it should support, and Hertel et al (2005) argue for careful implementation and training in the communication media. See further discussion in the chapter below on this subject.

9.2.1 Visual Planning adapted to multi-site teams

The difference between Visual Planning at a single-site and multi-site is quite small, the method is more or less the same and the social aspects are equally important but there is a different demand for technical solutions; the tool need to be adapted to fit multi-site. One aspect is for the whole team to be able to interact with the planning which was specified as important by Kaya, et al. (2014b) and it is also necessary according to Mascitelli (2007) since he specifies Visual Planning as an interactive method. Kaya, et al. (2014b) also highlight that the VP-board/s should automatically be updated to the other sites to erase the need of manual effort to synchronise them. Emerson also believe it is important for everyone within the team to be able to see and interact with the planning, but it something the members in Linköping has lacked. That led to the use of a digital Visual Planning tool to support every team member's interaction and communication. All reference companies that have teams at multi-sites use some sort of digital tool for their Visual Planning and other equipment to try to ensure social aspects.

The opinions about digital tools for Visual Planning are split, Swan (2015) believe there is a risk that the tool itself receive too much attention and focus should be on creating a good company culture and behaviour. However if goals concerning culture and behaviour has been reached one can use digital tools, the simpler they are the better. The interviewee at Scania has never experienced a digital planning tool that work and they gained better overview when they switched from MS Project to physical VP-boards. However, companies that use a software for Visual Planning are more positive (MS Project does not support Visual Planning). The interviewee at Rejmes and one at Autoliv highlighted the benefits of always having the VP-board with you, and not have to go to a physical VP-board to update the information. Two other benefits of using a digital board instead of a physical board is that the data is much easier to share and it will be saved, which makes it possible to track deviations (Kaya, et al., 2014a).

Yolean have been tested in the study for Visual Planning within both single-site and multi-site teams. This digital tool has many of the requested aspect for a tool that facilitate Visual Planning within a team; the data is saved, it allows several users at the same time and it have a built in structure which enables the company and team to keep a standard of Visual Planning. In addition it is possible to connect the notes to each other which make it possible to easier see how activities correlate and depend on each other.

To gain the benefits of Visual Planning for multi-sites it is import to have technology and facilities that support the meetings. Figure 9-5 shows an example of two screens used for multi-site short-term meetings, which are then seen from above in Figure 9-4. Figure 9-4 illustrates how a room could be designed to facilitate short-term meeting at multi-sites.

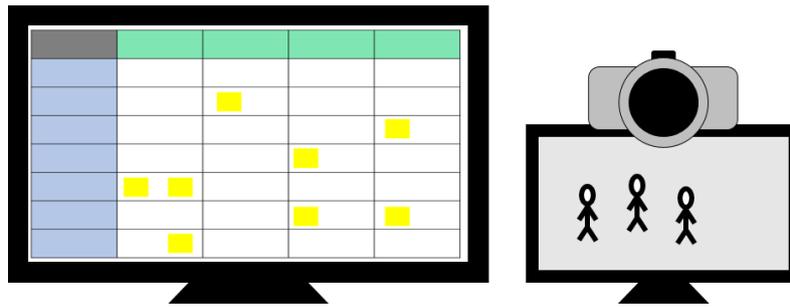


Figure 9-5: Visual equipment for Visual Planning and video communication

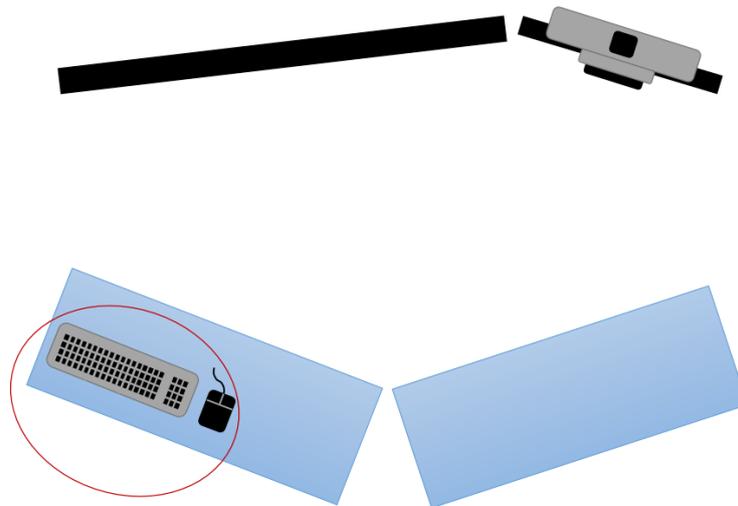


Figure 9-4: A room designed for multi-site communication. Note the circle which represents the speaker's corner, and the same screens seen from above as in Figure 9-5.

In this study, all reference companies that use a digital tool for Visual Planning have a touchscreen, but only Autoliv actually use the functionality for their one-site meetings. The other reference companies think it is simpler and faster to use a keyboard and a mouse to control the board. A keyboard and a mouse was used during testing at Emerson and it was not perceived as if they missed standing close to the board. There were some positive aspects, the participants did not stand in the way of the VP-board during meeting, as they sometimes did with the physical VP-board. One of the creators of Yolean believes the use of a touchscreen for digital VP-boards is important to stay close to the methodology of Visual Planning. However, this study has identified that the important aspect is that when the team members present their own row they should go to a specific spot, named "speaker's corner" and control the board from it, the red circle in Figure 9-4 above. The speaker's corner ensures that the team members have ownership of the meeting, otherwise there is a risk that the team leader takes too much focus at the meeting. The speaker's corner makes it possible for the meeting participants at the other site to see who currently control the VP-board. If a touch screen would be used at a multi-site meeting it be difficult to point the camera to include the whole team, one team members will stand next to the board and the other team members stand opposite to it.

All companies involved in the study have audio equipment to support multi-site meetings, and its importance have been identified as significant. According to Mascitelli (2007) phone calls are enough to coordinate meetings, but he does see benefits of using video at collaboration meetings. Some

teams at Emerson use video, while other only use conference phones. It is especially the team members in Linköping that miss the video feed when it is not used, but during the test period the team members in Göteborg expressed that they believed Linköping felt closer when a separate screen was used for the video link, due to they could see the meeting participants probably. One of the arguments against video equipment is technical issues, there is not time to waste several minutes of a meeting on faulty equipment. However, it is important to remember what Duarte and Snyder (2001) say, technology can affect a team's performance.

This study has found that video can lift social aspects of meetings between sites, but the quality of audio is crucial to avoid frustration. Inadequate sound aggravates understanding and simple exchange of information and participation in discussions becomes almost impossible. A solution Autoliv use is head-phones, but then the meetings are held at their own desks and communication is only by audio. However, Kaya, et al. (2014b) identifies this as a risk with digital VP-boards; that team members will sit by their own computer instead of attending meetings in person and thereby receive a lower output of information than if the meeting was face to face. Experience from Ericsson and Emerson have shown that video communication support the feeling of closeness between the sites, and have therefore been identified as a communication media that can support multi-site communication, but is not as vital as good audio equipment.

9.3 Generalisability and future research

The study have included eight reference companies, one case company where testing also has been performed and a literature study. This have given the possibilities to triangulate the data which strengthen the findings compared to if it only would have been one source of information. It has also given a base for the test period at the case company. Ideas from both the reference companies and the literature could be tested in a context of the case company. The case company have used Visual Planning for around half a year when the study begin and had probably similar challenges as other companies that have used Visual Planning for the same period of time. The study shown that it takes time to gain all benefits form Visual Planning, however project members and project leaders saw benefits with it after just a couple of months related to communication and the possibilities to see correlations. Due to the action research approach, the researcher have been involved in the testing and have a closer relationship to the case company than the reference companies. However, due to the use of triangulation and several reference companies these possible impacts have been limited.

The field of research and the companies have not one common definition or description of Visual Planning. This make this field difficult to study as the approaches used in the field differs and include various topics: Pulse methodology, Scrum and Visual Planning. The focus in the study has been on Visual Planning but input has been taken from pulse meetings and scrum to gain an overview and to see if approaches used within the Pulse methodology and within Scrum are applicable for Visual Planning. Common for all these methods and frameworks are the short stand-up meetings with the purpose to communicate and coordinate the operations. The challenges for these meetings are therefore similar, and multi-site teams that use the Pulse methodology or Scrum can input from the study as well.

The reference companies gave a broad view of Visual Planning, and shown that no company uses it in the exact same way as one other. The case company have adapted Visual Planning within their projects, but some of the reference companies used it mainly within their line organisation, and the

study will gain insight to both. However, all companies have the two same components: the VP-boards and the short-term meetings (i.e. stand-up meetings) even if they look and are done differently. The field of research is not so explored and focus mainly on these two components, but Visual Planning is more. In 2011 Lindlöf and Söderberg described Visual Planning as the planning board and the meetings, however in 2014 Lindlöf had evolved this to a more wider definition with focus on communication and coordination within the team. Emerson, the reference companies and the interviewee with Swan (2015) have contributed to the understanding of important aspects beyond the short-term perspective.

Some difficulties that have been identified is the creation of the long-term board, make sure the long-term and mid-term VP-boards are up-to date and the synchronising between the VP-boards. These are aspects that have not been covered in extent in the Visual Planning field of research before, but have gain some insight in the study. Within the field of research have the emphasis been on *why* a company should use Visual Planning and what it can gain from it, but there is a lack of research on *how* a company can implement Visual Planning and gain these benefits. The reference companies and the case company have contributed with practical solution on how a team can succeed with Visual Planning. This study is one step on the way to answer this, but it could gain even more focus in the long run especially the aspects related to the long-term perspectives of Visual Planning and its connection to a company's overall strategy.

The connection to sustainability within this study is mainly within the economic and social aspects. Visual Planning can support a company to keep their projects within time, and can in the long run help a company to decrease their product development times. This will help them to keep and take new market shares, i.e. be economical sustainable in the long run. However, the study focus mostly on the social aspects.

Visual Planning can help a team to create a common team feeling and involvement. If the team is located at different sites Visual Planning can make a team to succeed due to it creates a structure on a lowest level on how a team can communicate between sites. Earlier research within the field have said there need to be some adaption to make Visual Planning work on multi-site, however this study have shown that when some adaptations have been made, mostly concerning the technology, Visual Planning can be a reason for success within a team.

Visual Planning also gives the team members the possibility to plan their own deadlines and time, which can help them to feel motivated about their work. In addition the visualisation within Visual Planning will help a team to gain an overview on what should be done. This can reduce the risk of postponing the work or miss some aspects of the work that need to be done, which can help the team to feel secure that will not miss parts of the project and they will be able to work in an even flow and not to have to stress prior to deadlines. One of the team leaders within Emerson also highlighted that the work environment within the team had improved since they started to use Visual Planning.

10 Conclusion

This chapter focus on the conclusion of the study, i.e. at its overall research question, and includes practical findings this study has made within Visual Planning and multi-site teams. In the previous chapters several examples of solutions have been described from companies and some of these, or adapted versions, have been tested at Emerson.

Emerson’s wishes of what they want to achieve with Visual Planning can be seen as general for most companies who strive to improve themselves through the use of new methods. Therefore, the findings within Emerson and results from tests performed at Emerson can be seen as guidance towards companies who wish to start using Visual Planning.

This study has strived for every day, practical solutions to the study’s overall research question:

How can Visual Planning help multi-site teams to succeed?

The study have shown that Visual Planning can help a multi-site team to succeed. However, Visual Planning is not a universal solution that automatically will help a multi-site team to succeed. Visual Planning can support both a single-site team and a multi-site team if the team needs coordination and/or collaboration, Figure 10-1. Otherwise Visual Planning will take more effort than it give. Visual Planning will support a team through structured processes for communication and visualisation, Figure 10-1. Communication mainly refer to the meeting while visualisation is gained by the VP-board. However, the VP-board will also support the communication, but it must never replace the stand-up meetings. The visualisation both help the individual team members to gain a better understanding of their work and the team to see how their work correlates and to see what the team members do.

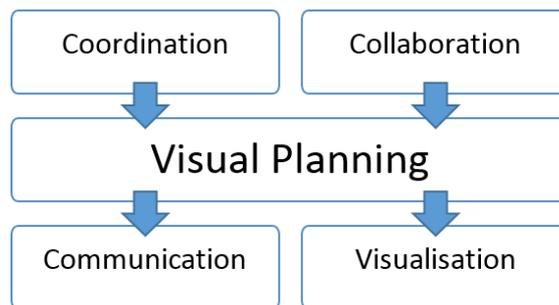


Figure 10-1: If there is a need of coordination and collaboration Visual Planning can support through structured processes for communication and visualisation

Multi-site teams is not that different from single-site teams, the main difference is that they do not get anything for free when it comes to communication and structure. Multi-site teams need technology support to be able to succeed, Figure 10-2. It is especially the social aspect that need extra attention in a multi-site team compared to a single-site team, and Visual Planning support this by supporting the team with a structure for communication, i.e. the stand-up meetings but also the VP-boards. However, informal communication is also of importance for the success of a team. Multi-site teams need technology that support face-to-face and informal communication between the sites, e.g. webcam and text-messages. It is also highly recommended that the team have a common kick-off to

give the team an opportunity to meet, both to socialising and to discuss the common work and purpose if it.

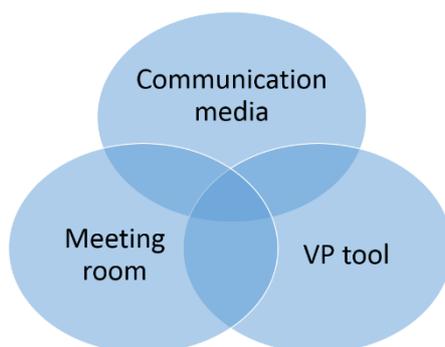


Figure 10-2: Technical aspects needed to support Visual Planning at multi-sites

To fully gain the benefits of Visual Planning in multi-site teams the entire team need to be able to see and interact with the VP-boards. A physical version cannot satisfy the level of interaction needed and therefore a digital tool is necessary. The one that has been found most beneficial in this study is YoLean, its single most important aspect was its closeness to the methodology of Visual Planning. In addition communication mediums and meeting rooms need to support multi-site communication. Good audio is the single most vital aspect, but video will simplify the communication through the feeling of the whole team being active and present at the meeting.

Also, a tool is only a tool and will only work as well as the one who use it knows. Knowledge about Visual Planning is crucial for its success and it take time to build it within an organisation, patience is necessary.

10.1 New findings from this study

The aim of the study was to find practical solutions for those who wish to have multi-site teams that use Visual Planning. In Table 10-1 specific findings from this study with largest impact on performance are presented.

Table 10-1: Important findings from the study with suggested practical solutions.

Category	Identified issues?	Suggested practical solutions
Meeting structure	When having meetings over several sites it is important that there is a clear structure so it is easier to follow. It is harder to ask for explanations and team members at different sites do not ask questions in between meetings as frequently as those that meet at coffee breaks.	Standard questions that should be answered during the meetings.
		Everyone should update their row prior to a meeting.

	To gain knowledge of best practice for one's own company there has to be simple methods of evaluation.	Do simple evaluations of meetings. That everyone writes two post-its, one for what was good and one for what need improvement, is enough.
	It easy to add more meetings when starting with Visual Planning, but the method of Visual Planning is to decrease total meeting time.	No unnecessary meetings! Think about the specific purpose of each meeting and how the different meetings relate to each other and the different VP-boards.
<i>Room design</i>	It is a lot harder to communicate between sites than when everyone is gathered in the same room and it can lead to loss of information and often irritation.	A good audio system is the single most important aspect when having multi-site meetings. And it also include that there is not a lot of noise close to the meeting or that the meeting room has good sound qualities (avoid echo for example).
	If a split team has an unbalanced number of members at each site the site with fewer members are easily forgotten if there is only sound.	A video feed ensure that the smaller part of the team will not be forgotten by any member of the meeting and also the conversation flows easier if the members can see each other.
	If a meeting room is too large it is easy for team members to hide a long walls. Team members has to stand close to create urgency, active participants and also to ensure that everyone can be seen in a video feed.	Mark a box on the floor with tape or post-its where team members are allowed to stand.
	Each team member has to present their own row on the VP-board and if the word is passed around the table it is easy that the team leader takes a larger role and interrupts the team members.	A speaker's corner ensure that the team members have ownership of the meeting.
<i>Technical aspects of Visual Planning</i>	In the methodology of Visual Planning a team member owns the word when standing at the board, but then the team cannot be captured in the same video angle.	Use mouse and keyboard at the tables instead of touchscreen.
	The standard of sticky notes on a wall does not include entire teams if these are in multi-site projects.	A software tool is recommended to ensure that everyone can interact with the plans (Yolean is recommended in this study, see

	chapter 7 for a comparisons of planning tools)
15 minute meetings can often start a few meetings late and can drag on for several minutes passed the time.	A timer or watch that the entire team can see during meetings create a sense of team urgency to finish on time. Start the clock even if all members are not present since the cost of time will be more visible.

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