The role of visual board in Project Management

Master's Thesis in the Master's Programme International Project Management

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Department of Civil and Environmental Engineering
Division of Construction management

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ABSTRACT

The aim of this research is to investigate how project managers are using visual boards to successfully deliver their obligations and to outline why such basic tool still exists in today's organization. *The methodology* used to carry out this study is qualitative combining semi-structured interviews and observation. *The findings* from these interviews show that there are several benefits with visual boards for the project manager e.g. improved communication, easier resource planning and improved motivation. These benefits have been categorized into informal and practical benefits. *The discussion* shows that the boards can work as a boundary object i.e. an artefact that enables and constrain knowledge sharing across boundaries. Working as a boundary object, the visual boards can be of help to overcome syntactic, semantic and pragmatic knowledge boundaries. Moreover, it has been shown to overcome social and emotional communication challenges through the improved motivation and that it brings people from different hierarchical levels together. *The conclusion* of the study is that the role of visual boards can be divided into a practical and a social role for the project manager. The board can be replaced by an IT-solution. However, the value of the physical limitations has to be considered.

Key words: Project Management, Visualization, Visual Boards, Boundary Objects,
            Communities of Practice

Rollen av visualiseringstavlor inom projektledning

Examensarbete inom masterprogrammet International Project Management

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Avdelningen för Construction Management

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SAMMANFATTNING

Syftet med denna rapport är att undersöka hur projektledare använder visualiseringstavlor för att framgångsrikt uppfylla deras uppgifter och varför ett sådant simpelt verktyg fortfarande används i dagens organisationer. *Metodologin* som har använts för att genomföra denna studie är av kvalitativ karaktär. För att samla in data har en kombination av intervjuer och observationer använts. *Resultatet* av dessa intervjuer och observationer visar att det finns flera fördelar med att använda visualiseringstavlor för en projektledare, exempelvis ökad kommunikation, lättarare resursplanering och högre motivation inom projektet. Dessa fördelar har delats in i praktiska och sociala fördelar. *Diskussionen* visar att tavlorna kan användas som "boundary objects", det vill säga ett objekt som möjliggör eller begränsar kunskapsdelning över gränser. Då tavlorna används som "boundary objects" kan de användas för att överkomma syntaktiska, semantiska och pragmatiska kunskapsbarriärer. Det har också framkommit att tavlorna kan användas för att överkomma sociala och emotionella kommunikationsutmaningar genom en förbättrad motivation och att tavlorna för personal från olika hierarkiska positioner samman. *Slutsatsen* av studien är att rollen av visualiseringstavlorna för projektledaren kan bli indelad i två kategorier, en social och en praktisk. Vidare är slutsatsen att tavlan kan ersättas med en IT-lösning, dock måste värdet av de fysiska begränsningarna att tas i beaktning.

Nyckelord: Projektledning, Visualisering, Visualiseringstavlor, Boundary Objects, Community of practice

Contents

Preface

This Master's dissertation is part of the Master Programme M. Sc. International Project Management at Chalmers university of Technology, Gothenburg, Sweden in collaboration with University of Northumbria University, Newcastle, England.

I would like to thank my supervisor, Martine Buser, at Chalmers University of Technology for all the support and advice given by her while writing this dissertation. The input and guidance given by her throughout the writing was much appreciated.

I would also like to thank the companies that agreed to participate in this study. I would especially like to thank the employees at these companies that was participating in interviews and observations.

Gothenburg, August 2016

André Dabäck

1 Introduction

1.1 Background

The role and the acceptance of project management has been developed and changed since the 1950s when project management as a profession first started to be recognised. Since the early 2000 there has been a widespread acceptance of the development of minimum standards for taking the role as a project manager and development of tools and techniques beyond the traditional ones (Maylor, 2010). The work of the project manager is complex and involves many different responsibilities; therefore there is a range of tools that supports the project manager. A lot of these tools have today been developed further and as in many other fields of profession, many of them have been replaced by some kind of IT-solution or a computer aided technology. For communication for example the range of tools available today is greater than ever (Association for Project Management, 2012) or in creating design where computers are more and more involved through Computer Aided Design (CAD) (Renner & Ekárt, 2003), which has been proved useful (Verroust, Schonek, & Roller, 1992). However, there are tools that have not yet been replaced by any IT-solution. One of these tools are visual boards that the project manager uses to plan the project and share information for the project team to know what is going on. This tool is used with the help of post-its that represent activities and a regular whiteboard inform the team on what is happening at the moment and what has been done. There are obviously some disadvantages with this tool such as the physical limitations and that post-its actually can fall down. Moreover, it can be argued that the knowledge transfer process also is made harder due to that the information on the board can be hard to save for future projects. So, why is such simple and mundane tool still used and up to date for the project manager? Could the project manager benefit from and make the project work even more efficiently by replacing this tool with an IT-solution? This report will answer these questions and additionally document and analyse how the tools are used today.

1.2 Research aim and research question

The aim of this research is to get an understanding of how project managers are using visual boards in order to successfully fulfil their obligations. Furthermore, it will highlight why such mundane tool still exist in today's organisations where the technological development has reached a level where one could expect this analogue tool to be replaced.

The main research question to answer is:
- What is the role of the visualization board for the project manager?

The following sub-questions will help to answer the main research question:

- What are the benefits with a physical visualization tool according to previous studies and theory?

- How are the boards used in practice in project meetings today?

- Can the boards be replaced by an IT-solution in the near future?

1.3 Research scope and limitations

This research will focus on the role of physical boards for the project manager. The manager is in focus but in order to get an understanding of the other participants' perspective they have been interviewed too. However, only two different companies have been observed. Both of these companies are production companies with a research and development department. Which is one limitation of this study, only one kind of industry has been looked at. Furthermore, the number of interviewees has been limited and an even better understanding could be gained if the number of interviewees was greater.

1.4 Structure of the dissertation

First, a theoretical framework is presented with focus on visualization and visual planning. Here, it is presented what current theory is stating about the benefit and the disadvantages with visualization and visual planning. A chapter about methodology will follow this section. This section will present how the researchers choose to carry out the study and what method is chosen for the gathering of data. The data gathered will then be presented in a section about empirical findings; the reader will also be introduced to the two companies where the data has been gathered. This will be followed by a discussion where empirical findings are compared with the theoretical framework and finally a section with conclusion will be presented

1.5 Theoretical rationale

The theoretical framework is beginning with some basic theories about project management. This has been chosen to introduce the reader to the role of the project manager and to give the reader an understanding of the main functions and obligations that the project manager is responsible for. Furthermore, as it is presented in the theoretical rationale, one most important task for the project manager is to create effective communication within the project team and outside the project boundaries. Therefore, theories about some of the challenges one can face regarding the communication have been mobilised. Following, the role visualization and how visualization can support the project manager according to theory, is presented: first one can read about how visualization can be supportive in general for the project manager than there is some theory about how visual planning can support the project manager in its tasks. Since one of the two companies studied has built up their visual boards according to the lean principles there is a brief description regarding lean and visualization. The project manager has both social and practical responsibilities and to investigate the former, the concept of boundary objects has been selected. This theory describes how objects can be used in order to overcome different knowledge boundaries, which have then been used in order to compare the findings from this study to see if and how the visual boards can be used to overcome these boundaries. Furthermore, the concept of communities of practice also helps to explain the social side of the project manager's responsibilities. In order to understand and explain the advantages that the project team can gain from

working as a community of practice and how the project team can be seen as a community of practice this theory has been used. Thus, the theory about the communities of practice gives a deeper understanding why the board working as a boundary object comes with the advantages described.

2 Theoretical Framework

This section will provide the reader with an understanding about project management and the theories used in order to answer the research questions of this study. First the functions of the project manager are presented. This is followed by a section of visualization and visualization in project management. Thereafter, theory about boundary objects and communities of practice is described.

2.1 Functions of the project manager

The Association for Project Management (2012) is describing many different functions that the project manager has to be able to deliver. (1) The project manager has to be able to govern the project. Governance includes both internal and external control. The internal control is about governing the project and monitor progress against the plan (Association for Project Management, 2012). The first step in planning a project is to break it down into activities. This should preferably be done using graphical tools since this provides the greatest potential for others involvement and therefore enable consideration of their perspective (Maylor, 2010). (2) The project manager is also responsible to manage risks, issues and changes that occur during the project (Association for Project Management, 2012; Maylor, 2010). To reveal these problems and prevent them of happening it is important to get an overview of the project (Maylor, 2010). (3) The efficient use of resources is also the responsibility of the project manager; these responsibilities include e.g. allocation, aggregation and scheduling. Moreover, early identification of resource bottlenecks and conflicts is important for the progress of the project. (4) The project manager is responsible for leading and motivating its team. (5) Knowledge management is also one of the responsibilities of the project manager, by efficiently manage the knowledge within a team the project manager can make the project more efficient. (6) Communication is essential in a project and the project manager has to make sure to convey meaning as accurately as possible so that his/her message delivered is the one received by the receiver. The execution of the communication is something that is affecting the feeling and the understanding. For communication to be effective it needs to be a two-way process and that information is available easily otherwise the information is of no use (Association for Project Management, 2012).

2.2 Communication challenges

Eppler and Platts (2009) describe the difficulties with communicating in a company. These challenges are divided into three different categories, cognitive (e.g. information overload), social (co-ordinating multiple groups and hierarchies) and emotional (motivate employees). Visualization can help to overcome challenges from all of the different categories mentioned. Cognitive challenges can be overcome by visualization since the visualization helps to compress information and makes pattern detections easier i.e. information and data gets simpler to analyse. It is also shown to increase creativity and expand working memory. Social challenges such as collective sense making and the fact that employees have understood the managers properly can be overcome by visualization since graphic metaphors promote mutual understanding by making

assumptions explicit. Emotional challenges can be overcome by visualization since picture can create involvement and inspire to motivation (Eppler & Platts, 2009). Furthermore, visualization promotes effective and standardised communication, this in turn creates good opportunities to effectively work with continuous improvements. Organisations today rarely struggle with getting the right information but rather communicating the right information in an effective way. In order to do so the information has to be clear, visible and simple in its presentation. One of the reasons why visualization can be such an effective way of communication might be due to the fact that sight has been shown to contribute with 75 per cent of the learning experience (Jaca, Viles, Jurburg, & Tanco, 2014).

2.3 Visualization in project management

"Visualization concerns the representation of data, information and knowledge in graphic format which is conducive to acquiring insight, creating a vivid picture, developing an elaborate understanding or communicating experiences" (Lengler & Eppler, 2007)

Visualization offers a systematic approach to transfer knowledge between different parties such as individuals, groups or from individuals to groups. Furthermore, Whyte, Ewenstein, Hales, and Tidd (2008)s study shows that visual practices provides a bridge between project work and the wider organisation. Visual practices can make the on-going work in a project visible for the wider organisation through e.g. charts and diagrams (Whyte et al., 2008). However, to do so the receiver has to recreate the knowledge in its mind and this depends on its cognitive capacity. Graphics can help the receiver to create a context where the cognitive capacity of the receiver is increased. This also makes it easier to transfer knowledge across different functions i.e. stakeholders and experts with different professional background. It also gives an opportunity to create new knowledge in groups, which can improve innovation. Furthermore, it can prevent information overload, which makes it easier for individuals to absorb knowledge. The visualization formats can be divided into seven main groups; structured text/tables, mental visualization and storytelling, heuristic sketches, conceptual diagrams/concept maps, visual metaphors, knowledge maps and graphic interactive environments (Eppler & Burkhard, 2007).

A project manager has many responsibilities; among these are planning, creating effective communication in the team, resource planning and govern the progress (Maylor, 2010). The first step in planning a project is to break it down into activities. This should preferably be done using graphical tools since this provides the greatest potential for others involvement and therefore enable consideration of their perspective. However, the positive aspects of planning is only realised when communicated (Maylor, 2010). The communication and the language used in projects have to be neutral, clear and objective and should avoid emotive terms. Good communication is characterised by being a two-way process (Association for Project Management, 2012). When different departments, such as in a project have to communicate with each other visualization can help to increase performance of the communication (Gebhardt & Krause, 2015). Furthermore, to outline the project it is important to get an

overview of how the project can proceed and reveal problems that might appear in the future and how to prevent these problems (Maylor, 2010). An important part of the planning is the planning of resources and the scheduling of these resources. This involves both reusable resources, such as humans, and non-reusable resources. The scheduling of resources is important to ensure efficient and effective utilisation and early identifications of bottlenecks and conflicts. These resources have to be controlled and governed. Good governance can be created through fostering a culture of improvements and disclosure of information and procedures that enables the management to call for an independent scrutiny of projects (Association for Project Management, 2012). Some of the basic requirements on a control system are (Maylor, 2010):

- Making progress visible
- Feedback to team of performance
- Instituting corrective actions where required

(Maylor, 2010)

Visualization can support the project manager when carrying out these obligations since visualization makes the process of the project transparent. A clear overview is created and it can help the project manager in prioritising (Lindlof & Soderberg, 2011).

2.3.1 Lean visualization

Organisations that have been implementing lean have shown significant gains from this according to Poksinska, Swartling, and Drotz (2013). However, it has also been found that the improvements have stayed within that specific unit and are unable to transfer the learning further in the organisation. A change in the management and the way managers' are communicating is required. Lean management systems consist of four different principles; leader's standard work, visual control, daily accountability processes and discipline. Visual tool are used to communicate goals and give updates about process performance. Lean leadership is, among other things, about empowering employees, which can be done through visualization. Furthermore, it is used to create a learning work environment (Poksinska et al., 2013).

2.3.1.1 Obeya room (Big Room)

In a project there can be a lot of dependencies between different parties within the project. Getting the different parties together at the same place can promote solving any problem that might appear due to this. The goal is to create an environment where the parties can collaborate and therefore reduce decision-making latency. To bring different parties whose work is affecting each other will shorten the time for modelling and coordination (Olofsson, Lee, Eastman, & Reed, 2007). The room works as a way for communication and planning in a project (Lindlof & Soderberg, 2011).

2.3.2 Visual management success factors

Some success factors for a visual management systems have been identified by Parry and Turner (2006) in their case studies about visual management. These success factors are (1) a team must be empowered to create their own visual board in order to be adapted to each specific team's needs, (2) the board should

be kept simple and kept clear from unnecessary information. (3) A colourful physical visual control system should be used whenever possible and electronic systems should be avoided since it might bring a lot of unnecessary information to the system and if used the content will be controlled by a small group of people that understands the software. Physical notes however can be changed by anyone. (4) Senior management has to be dedicated and fully support the visual management system. (5) Ensure that all team members understand and are in control over their own board. (6) Regular meetings around the board will make sure that it evolves into a useful tool. (Parry & Turner, 2006)

Further, to successfully transfer knowledge through visualization at least five perspectives should be considered.

- What type of knowledge is visualised?
- Why should the knowledge be visualised?
- For whom is the knowledge visualised?
- In which context should the knowledge be visualised?
- How can the knowledge be represented?

(Eppler & Burkhard, 2007)

2.4 Visual Planning

As has been stated in 2.3, visual practices have been used in order to enhance communication flow, both within and outside a project. In order to increase this cross-functional communication visual planning boards is one practice that has been used (Lindlof & Soderberg, 2011; Parry & Turner, 2006). Visual management has been used in order to integrate diverse knowledge in complex developments. Visual planning can also be a tool to help managers prioritise and makes employees more involved in decision-making. Furthermore, visual planning has been a connecting point for projects where engineers can meet and discuss what the next step is in development projects. An argument for using visualization is that the brain can process images more easily than text, which makes it useful as a tool for knowledge sharing. As been mentioned previously in 2.2, information overload is a common problem in knowledge intensive firms and the solution of such problem can be to visually present the information. The quality and the speed of knowledge transfer can even be increased through visualization. Teamwork has to be increased by visual displays and even that knowledge transfer has been achieved (Lindlof & Soderberg, 2011).

2.4.1 Benefits of visual planning

The benefits with visual planning are that the short meetings makes it difficult to discuss things in detail and if something needs to be discussed in more detail the actors that are concerned should take that outside of the meeting. The advantage of this is that team members not concerned by the issue do not have to spend time on listening to discussion that do not concern them. The visual planning also creates a forum where both planned and ad-hoc information sharing can take place and team members can respond to others issues (Lindlof & Soderberg, 2011). In this way the visualization enables people engagement and contributes to the benefits mentioned in 2.2 i.e. it enhances communication and support

continuous improvements. Furthermore, the use of visualization increases the interactivity between different units and hierarchy levels. To be able to enjoy these benefits, democracy of information needs to be created, this would engage people in idea generation and foster innovation (Bititci, Cocca, & Ates, 2015). This indicates that visual planning can be used for breaking down barriers between functions and enhance cross-functional information sharing and create cohesion in the team. When having a group of experienced and non-experience people this aspect is even more important since knowledge transfer is desired (Lindlof & Soderberg, 2011). When it comes to knowledge transfer visualization has been proved to be useful, by adding visuals to words both learning and transfer of learning is improved (Bititci et al., 2015). The benefit that can be argued to be one of the most important ones is that visualization enables a better overview of the project and what is happening at the moment and therefore bringing transparency to the process (Lindlof & Soderberg, 2011; Parry & Turner, 2006). The transparency enables quicker decision making and it also makes it easier to identify waste, such as rework and gaps in activities (Jaca et al., 2014), which improves productivity (Bititci et al., 2015). Levelling of work gets easier for the managers due to the frequent updates of the schedule. The frequent updates make the team members to specify their current activities, which forces them to bring up problems in an early stage and they can be dealt with early. Moreover, the physical limitations of the board can be an advantage since it forces the user to be restricted with the information on the board leading to that only the most relevant information are presented (Lindlof & Soderberg, 2011). This also creates an opportunity to get an indication of what the organisation is prioritising since what is visualised also must be important due to the physical limitations. Moreover, the visualization can also work as a reminder of problems while people are working on a solution, in this way the problem is not forgotten (Whyte et al., 2008).

2.4.2 Disadvantages with visual planning

In organisation where there are many different specialty competencies, difficulties can appear when handing over the work. Visual planning can be interpreted as a way for management to control the personnel (Lindlof & Soderberg, 2011). Moreover, in companies that have a command-and-control culture the visualization can create an anxiety from top management to reveal sensitive information for a large group of people (Bititci et al., 2015). Other disadvantages with visual planning are that it does not work on global teams, which is due to that the sticky notes are physical artefacts which is hard to make digital, since the sticky notes are just thrown in the trash bin when used it is hard to share knowledge outside the team. Furthermore, since the board is not digital, there are no function that can show how other team members are affected when moving the activities/sticky notes. For visual planning to be effective, the team has to have a need to coordinate themselves with other team members, if not there is no point of using visual planning. The team should not be neither too small nor to big, a rule of thumb can be to have between 6 to 12 persons in the team (Lindlof & Soderberg, 2011), a too large amount of people to share information with could create problems.

2.5 Boundary objects

"Boundary objects are artifacts that enables and constrain knowledge sharing across boundaries"
(Spee & Jarzabkowski, 2009, 6)

Boundary objects have earlier been presented as a way of managing the tension between divergent viewpoints. Furthermore, they serve to support negotiation between parties with different meaning. However, they could also exist within communities of practice to satisfy their information requirements. When a boundary object becomes a link between one or more organising networks it creates a new organising system or network. In this way a boundary object could be seen as a prototype. Furthermore, where joint actions are required, a common ground is required (Subrahmanian, Monarch, & Konda, 2003). Project work is one such occasion where people from different functions meet and when sharing of knowledge across these communities gets crucial (Whyte et al., 2008). This is supported by Goh (2002) that states the importance that the two parties, the receivers and the providers, in a knowledge transfer process has the right knowledge to be able to understand each other, this is to increase the absorptive capacity of the receiver. Therefore, where lacking common ground, efforts should be pointed in order to create this common ground. This common ground can be created by developing a common language or by using material objects (Bechky, 2003; Subrahmanian et al., 2003). Effective use of a boundary object creates integration of knowledge across boundaries. When not in use they can serve as storage for particular aspects of shared knowledge and language (Spee & Jarzabkowski, 2009). Moreover, boundary objects do not only serve to create a shared language, they can also be used in order to reveal boundaries within an organisation, especially the one that is more complex than syntactic boundary. Sometimes boundary objects do not create a shared meaning but it can reveal what semantic and pragmatic boundaries constrain shared meaning. These different types of boundaries will be presented further in 2.5.1, 2.5.2 and 2.5.3. Furthermore, visual objects can indicate what the organisation are prioritising since organisation only visualise what is important for them. These kind of tools can also be used as a reminder of problems that exist (Whyte et al., 2008).

Simple tools are preferable over more sophisticated tools since they can create a common language and are often more flexible. Thus, they become easier to understand and interact around (Spee & Jarzabkowski, 2009). In this way boundary objects can play a conversational role between parties rather than a problem-solving role (Spee & Jarzabkowski, 2009; Whyte et al., 2008). The conversation that is created between people and the object can be crucial for the learning, the transfer of knowledge and mediating boundaries between communities (Whyte et al., 2008).

A good boundary object has three important characteristics. First, a boundary object should create a shared syntax or language. A boundary object cannot be effective if not the concern of every function involved can be represented. Secondly, the different participants have to be able to express what they know and what their concerns are. This will outline the differences and the dependencies across the given boundaries. Thirdly, the participants should be

able to change the object in order to solve the problems that come with the dependencies (Carlile, 2002). Spee and Jarzabkowski (2009) emphasize on the importance that the boundary object makes sense and is relevant for all of the participants.

Carlile (2002) presents three different types of knowledge boundaries; syntactic, semantic and pragmatic.

2.5.1 Syntactic

A syntactic approach to knowledge boundaries suggests that if a sender and a receiver have shared syntax, knowledge can be transferred between the two parties (Carlile, 2002). Viewing this from an organisational context would be when specific arrangements and agreements have been taken between divisions, which would make them contract within the internal supply chain effectively (Spee & Jarzabkowski, 2009). However, problems appear when a new condition appears and the syntax might not be sufficient to deal with these conditions. When this appears, a new syntax might be needed in order to create effective communication (Carlile, 2002).

2.5.2 Semantic

Sematic boundaries are more complex than the syntactic. In order to be able to transfer knowledge the receiver and the sender has to create a common understanding. Even though a shared syntax is created between two functions, these functions might interpret information in different ways. To recognise the differences between how people interpret information and also the dependencies between different functions is necessary to understand from a sematic approach of knowledge boundaries (Carlile, 2002).

2.5.3 Pragmatic

Pragmatic boundaries are the most complex of the three. This is due to that common interests have to be created in order to transfer knowledge between different functions when using this approach. To be able to deal with problems individuals have to be able to alter their own knowledge but also have the opportunity to influence or transform the knowledge of the other function.

Building on this pragmatic approach of knowledge, Carlile (2002) argues that knowledge is localised, embedded and invested in practice. That knowledge is localised does not mean that it is localised to a specific situation or location. Knowledge can be widespread over different locations and situations. Knowledge can be similar across practices if it is localised around a similar set of problems. That knowledge is embedded in practice means that the further individuals are from each other's practices the harder it will be to transfer knowledge and translate the knowledge embedded in their practices. Knowledge is also invested in practices i.e. if knowledge is proved to be useful in problem solving; individuals are likely to use this knowledge to solve problems in the future. Due to this the individuals are less adoptive and open to change their knowledge to knowledge developed by other groups. This is due to that individuals use their knowledge in order to demonstrate their competence in solving problems.

These characteristics can have positive impact for problem solving within a practice. However, the same characteristics can be problematic when working across practices (Carlile, 2002).

Carlile (2002) describes how these can be problematic within a new product development project since the different functions within the project have different aims and interpret the goals of a project differently i.e. the sales department aiming at getting the numbers right which affects the development that has to add different parts to the product in order to meet specification. In turn, this affect the production since cycle time has to be reduced in order to produce in a pace that matches forecasted sales. To be able to communicate and share knowledge between practices in this particular example boundary objects in form of a CAD drawing was used so that production and development could discuss around it (Carlile, 2002).

Whyte et al. (2008)s study shows that business managers can make more deliberate choices for the visual representation of knowledge in order to align the project with explorative and exploiting opportunities.

2.6 Communities of practice

A community of practice is a group of people that is working in a certain domain and are engaging in a process of learning. Examples of communities of practise are a group of engineers working to solve a certain problem or a tribe learning how to survive (Wenger, 2011).

"Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly." (Wenger, 2011)

A community of practice has three important characteristics. A community of practice has an identity defined by a shared domain of interest. It is not just a network of people where people could belong without meeting each other. Working within these certain domains requires dedications. Members within this domain should actively share information and learn from each other. They should have discussions and engage in joint activities. This characteristic is called the community. Members of communities of practice are practitioners i.e. they have to practice in the specific interest the community is working with. This means that a community of practice is not just a group of people that share a common interest, such as an interest in movies (Wenger, 2011).

The concept has been used in organizations as a way of managing knowledge since knowledge has been recognized as an important asset in a company. There are some characteristics of communities of practice that has made it interesting for businesses (Wenger, 2011).

- Communities of practice enable practitioners to participate in the knowledge sharing and by giving them the proper structure they are in the best position to do so.

- Communities among practitioners create a direct link between learning and performance.
- Practitioners can address the tacit as well as the explicit knowledge.
- Communities are not restricted by formal structure; they make connections to people across organizational and geographical boundaries.

Communities of practice are characterized by autonomy, practitioner-orientation and crossing boundaries. These characteristics are creating the advantages described above. (Wenger, 2011). Novak (2007) show through his study that visualization can be a good support for transfer of knowledge across boundaries between communities.

2.7 Visualization through software

In the case study made by Olofsson et al. (2007) it is shown that there are a number of advantages by using visualization software, in order to coordinate different actors of the project team. Some of the benefits were that the project team did not spend time on non-value adding activities, architects and engineers did spend less time with administration, there was less time spent on "firefighting", it was less rework and problems had appeared earlier in the design phase which meant less problems in the construction phase (Olofsson et al., 2007). The visualising also creates a better understanding, thus gives a better understanding of the problem (Songer, Subramanian, & Diekmann, 2000) and improves communication (Khanzode, Fischer, & Reed, 2005). However, Lindlof and Soderberg (2011) claim that the use of software makes engineers communicate less than if they used a physical tool. The lessons learned from the project were that all actors concerned during the coordination phase should be in the Big Room. The Challenges during the project was how to organise the project team, how to set up the technical logistics and how to perform the coordination of the Big Room (Olofsson et al., 2007). In dedicated project rooms, technology that is supporting creation, editing and persistence of flexible documents is essential for coordination. There is however a difference between how team members use shared displays and how they use technologies. By using visual displays the team members can create a shared format of the presented data. A single display provides a ready reference to coordinate information. There are some visual software tools that can create a shared representation of information via pen-based interface. What is important to consider when designing a dedicated project room is how technology support tightly coupled and loosely-coupled project team (Covi, Olson, Rocco, Miller, & Allie, 1998). According to Covi et al. (1998) a team that is co-located are preferable over a geographical distributed team. Cooperative building can support collocated teams and also extend these benefits to a remote team through exploring new technologies (Covi et al., 1998).

2.8 Summary of theoretical framework

Different functions that the project manager has to play have been presented in this chapter. These are the following functions:

1. Governance
2. Manage issues, risks and changes
3. Efficient resource planning
4. Leading and motivating the team

5. Knowledge management
6. Communication

Moreover, in this chapter communication challenges have been presented. These challenges can be divided into three different categories, cognitive, social and emotional. Visualization can overcome these challenges since it creates a mutual understanding, helps to compress information and it can create motivation.
Benefits of visualization have been presented such as that it can create a clear overview of the work and that it can create motivation and engagement. Some disadvantages have also been presented. Some of them were that visualization could create a feeling that management were controlling the team and that physical visualization does not work on global teams. The concept of boundary object have been presented, a boundary object is a object that enables or constrain knowledge sharing across boundaries by for example creating a common language. Three different types of knowledge boundaries have been presented. Through a syntactic approach to knowledge boundaries a shared syntax or language has to be created between receiver and sender. Through a semantic approach, a shared meaning has to be created in addition to the shared syntax. Finally, through a pragmatic view a shared interest has to be created so that knowledge can be transferred. Thereafter, a section about communities of practice was presented. A community of practice is a group of people that is working in a certain domain and are engaging in a process of learning. Finally, visualization through software was presented and benefits that earlier theory brings up.

Function / Benefits	Governance	Manage Risk, issues, changes	Resource planning	Leading and motivating	Knowledge Management	Communication
Improved Motivation				x		
Drives efficiency				x		
Understanding for each other work					x	x
Simple to use			x	x		

Figure 1 - Summary

3 Methodology

This chapter will describe what methodology has been used in to carry out this research and what methods have been used to collect data.

3.1 Research Strategy

3.1.1 Qualitative vs. Quantitative research strategies

The qualitative research strategy is focusing on understanding individual's interpretation of the social world. This world is looked upon as constantly changing and affected by the individuals acting in it. A quantitative research strategy however, is focusing on quantitative data (Bryman, 2012). With regards to the aim of this study the qualitative research strategy is fitting due to that in order to understand what role visualization boards have to the project manager, one has to be able to see their work through their eyes. Furthermore, to understand the benefits and if the visual boards can be replaced with e.g. an IT-tool it is important to understand the project participants as well as the project managers understanding of the tool. These factors make a qualitative strategy very well suited for this study and neglect the use of a quantitative research.

3.1.2 Research approach

There are different approaches to perform qualitative research. In a deductive approach the theory is generating a hypothesis and observations are used to gather data that is either supporting the hypothesis or neglecting it. In an inductive approach however, theory and generalisation is drawn from the observations (Bryman, 2012). However, this study fits neither of these approaches and rather takes what Dubois and Gadde (2002) refers to as abductive. The framework from this kind of studies is successively modified. The changes made are grounded in unexpected empirical findings but also from theoretical insight gained during the process (Dubois & Gadde, 2002).
In this study a first theoretical framework was built up from the start so that the researcher could build up an understanding of the subject. This framework was then constantly changed and updated due to unexpected findings during the gathering of data.

An approach of interpretivism is described as trying to understand the world around the participants. There are two ontological approaches that one can take in a study, objectivism and constructionism. The latter means that a view is taken where there is a belief that social actors are affecting the social objects around them (Bryman, 2012). This makes sense since people tend not to follow standards and rules perfectly as objectivism would like to think (Bryman, 2012). In regards to the research aim and to be able to answer the research questions in this study, the researcher has to understand how project managers use visual boards and what benefits it brings to the project. This indicates that an epistemological approach of interpretivism is taken. Moreover, this study takes an ontological approach of constructionism.

3.1.3 Case study design

A case study is a detailed study of a case. The study could be executed in an organisation, a family or in a single event in time among other things. Case studies are commonly connected to qualitative research. However, case studies are used in both quantitative and qualitative research. It is true though that the case study often favours qualitative methods such as participant observation and semi-structured interviews. Different researchers have been focusing more on the reliability, validity and replicability within a case study and some researchers have barely focused on these criteria at all. However, external validity and generalizability has been discussed and the concern is how one case can be viewed as a sample that can be representative for a whole population? The answer is that it cannot. The conclusion of this is that the generalizability in a case study is very low. There are different types of case studies. The critical case is when the researchers have a well-developed theoretical framework and is choosing its case in order to test if the researcher's hypothesis about the subject holds or not. The extreme or unique case is when the case studied is chosen due to its unique characteristics. The representative or typical case is a case where the researcher believes that the case studied can represent a larger category. A revelatory case is a case that is chosen because researchers have not had access to the case before. A longitudinal case is a case that can be studied during a long period of time (Bryman, 2012).

The cases chosen in this study were chosen due to a number of factors. It was important that the companies were working with projects since it was of great importance to interview project managers in order to answer the research question, therefore it was important that the organisations were project-based. The location of the company was also important so that the researcher could visit the companies several times. If the location of the companies had been far away complications would probably have appeared. Moreover, in order for the company to be interesting to observe they needed to work with visual boards so that the researchers could get an understanding of how these boards are used today. The size of the company is another selection criteria, it was important to find companies big enough to gather a number of people from different departments in the projects. This required the companies to be at least medium-size. Furthermore, one obvious but important factor was that the companies had time to take me in and had the time to let me observe a couple of meetings and that enough people had time to meet me for an interview afterwards.

3.2 Data Collection

The data in this study has been gathered through semi-structured interviews and observations. The chosen data collection strategy was chosen with regards to the research question and the aim of the research. To understand the role of visualization for the project manager the semi-structured interviews was used. More specifically questions were asked about how visualization supported the project manager during meetings and in other situations communicating with participants in a project team. Furthermore, participants in project team were also interviewed in order to get a sense of their understanding of visualization as well. The observations were used to identify any behaviour that was not

described in the interviews and to see how different participants acted around the visual boards.

3.2.1 Interviewing

Interviewing in qualitative research tends to be more open than in quantitative interviewing. This due to that qualitative research is more concerned to understand the interviewee's own perspective and its point of view. Therefore, rambling and going off at tangents is often encouraged. This also gives the interviewer the right to take another way than the schedule is proposing. This means that the interviewer can ask new questions if the interviewer finds it necessary. This kind of interview approach promotes rich and detailed answers (Bryman, 2012).

There are two major approaches to interviewing within qualitative research, unstructured and semi-structured interviewing. In the unstructured interview the interviewer might just ask one question and let the interviewee speak freely about the topic or question. The interviewer only responds to things that seems interesting and that the interviewer wants the interviewee to elaborate (Bryman, 2012).

In a semi-structured interview the interviewer has a list of fairly structured questions. This is referred to as the interview guide. The interviewee however has a lot of space to freely answer the questions. Furthermore, the interviewer can use questions that are not in the interview guide. However, over all the same wording will be used with all the interviewees. Semi-structured interviews will preferably be used when the researcher has a fairly clear focus so that the specific issue can be addressed (Bryman, 2012). This later approach to interviewing was chosen for this study. The reason for choosing this approach was because of characteristics of the study. As Bryman (2012) describes, semi-structured interviews should be used when the researchers have a fairly clear focus of the study. This has to be considered the case with this study. The study will investigate what role visualization plays for the project manager. The interviews and the interview questions were then aimed to gather information to answer this question. However, it was also important to let the interviewee speak freely around the questions in order to gather data that was unanticipated for the researcher and to get as detailed information as possible from the interviewees.

Before preparing the interview a thorough work with the research question and the theoretical clarification should be done. Furthermore, the researchers have to consider if a qualitative interview is the right way to conduct data for the study. An indication could be that the research question is beginning with a how, since this is an indication that the researcher wants to get an understanding about how the participants understand their social world (Brinkmann & Kvale, 2015).

By being in the environment where the interviews are to be conducted could give the researcher a good idea of the language and daily work for the interviewees (Brinkmann & Kvale, 2015).

Brinkmann and Kvale (2015) describe an interview study in seven steps:
- Thematising – Formulate research question and hypothesis if there is any.
- Designing – Planning the interview with the interviews or organisation.
- Interviewing – Preparing a guide for the interviews and perform interview.
- Transcribing – transcribing the interview.
- Analyse- Categories the interviews in a suitable way.
- Verifying – Reliability and validity checks should be done throughout the project.
- Reporting – report the result.

To prepare an interview in qualitative research, the researcher preferably prepares an interview guide. The interview guide can consist of a list with topics that is going to be covered during an unstructured interview or a list of questions in a semi-structured interview (Bryman, 2012). It is of importance that the questions and the topics are flexible so that the interviewee can describe the social world as they see it. To prepare for the interview the researcher should figure out what is interesting with the subject and what he/she would like to get out of it. Even though the qualitative interview is significantly more open than a quantitative interview it should be structured enough to still keep the research focus. Some of the basic elements in preparing an interview are to create an amount of order of the topics so that the questions flow reasonably well. However, the interviewer has to be prepared to change the orders of the questions during the interview. Furthermore, the interview questions should be structured so that the research question will be answered. After the interview the interviewer should document how the interview went, where the interview took place, any particular feelings about the interview and the setting around the interview (Bryman, 2012).

For this study the interview guide consisted of interview questions. The questions were structured by topic so that it would be a good flow in the questions. However, the order was not always followed in that exact order that they were outlined in the interview guide, a certain amount of adaption was integrated in the interviews and if it made more sense to change the order of the interview questions the interviewer did so. The questions from the interviews can be found in the Annex 1.. After the interview, notes were taken where the interview took place and which date the interview took place.

In this study there were seven interviews carried out. In order to get an understanding of how people from different departments uses and interpret the use of the boards. Furthermore, to see how the boards was used at different companies the interviews were relatively equally divided between the two companies, four interviews at one company and three on the other company. A list of the different interviewees, which company and which department they are from is presented below. The interviewees were interviewed in the order presented below.

Table 1 Interviewees

	Company A	Company B
Interviewee 1	R&D Manager	
Interviewee 2		Project Manager
Interviewee 3	R&D Manager	
Interviewee 4	Product Coordinator	
Interviewee 5	Product Coordinator	
Interviewee 6		Service technician/Environmental coordinator
Interviewee 7		Product development manager

What is worth mentioning is that even though there is only one project manager interviewed, all of the managers were or had previously been responsible for projects and therefore had good insight in what role the boards had.

3.2.2 Transcribing

There are several reasons why interviews should be transcribed. Transcribing makes it possible to more thoroughly examine what people say and it allows the researcher to examine the interviewee's answers several times. Since, the material gets written down it allows for the public to control what the researchers have done and therefore it allows them to detect any biases in the interview. Furthermore, it allows the data to be used in other context than the one first intended. However, the disadvantage is that it is very time consuming. It is important that the researcher plan the number of interviews so that him/her have the time needed to transcribe them (Bryman, 2012).

There are some issues in the translation from audio to written language. However there are not many standard rules but there are some choices to be made. The most important decision to make is which style the transcribing should take. When this decision is taken the researchers should stick to this way of transcribing. Choices that has to be made is if the transcription are to include "mmh", laughter and pauses or should it be written more as a formal text (Brinkmann & Kvale, 2015).

The interviews transcribed in this study have all followed the same style. The interviews was transcribed as soon as possible after the interview. Moreover, what the interviewee said was written down without any laughter, pauses and "mmh". Furthermore, the transcribing has enable a thorough review of the interviews and the recordings enable the interviewer to listen to the interviews again and get a more accurate understanding of the interviewee.

3.2.3 Observations

Observations can be a good tool to use in order to check if what people say about themselves are actually the reality. Observations are a qualitative method used in order to understand a population's perspective of their social world. The researcher should take objective notes about what is observed. Furthermore, by

performing participant observations the researcher can reveal problems with the study that was not revealed in the beginning of the study. This could be of importance even though truthful answers can be collected from interviews, the researcher might not ask the right questions (Mack, Woodsong, MacQueen, Guest, & Namey, 2005). The reason for the choice of using observation in this study was to get an understanding of how different members as well as the project manager was using the visualization tool. Furthermore, it was used to see if there were any differences in how people said they were using the tool and how they actually acted during meetings.

A disadvantage with participant observations is that they can be time consuming and in some cases the researcher might spend a year in the field. For most research this is not a preferred way of collecting data since most research requires a faster way of collecting data. Moreover, it can be hard to document the data collected in an observation since findings sometimes cannot be written down right away. Therefore, it is important to as soon as possible write down important findings. The documentations has also some degree of inherently subjectivity whereas research needs objectivity (Mack et al., 2005). In order to deal with the time consuming problem five relevant meetings where chosen at two different companies that was located in the close area of Gothenburg. This enabled the researcher to be able to use this data collection method without it being too time consuming.

The data from observations are of a large extent field notes taken by the researcher. These field notes have to be transferred into computer files. The data in an observation is usually combined with other forms of data from other methods such as interviewing. When retrieving this data there is some ethical consideration that should be considered in order to collect data in a correct way. The researcher should be discrete when observing the participants; this is so that the participants are acting as normal as they can. Participants should be kept confidential, which requires the researcher to leave out personal information. Personal characteristics must also be left out to cover the integrity of the participant (Mack et al., 2005). Accordingly, the researcher kept a low profile to affect the participants' behaviour as little as possible. Moreover, an explanation of why the researcher was there took place so that they understood that it was not to evaluate them in any way.

The researcher was observing five meetings where visual boards were used. These meetings were of different character. Three of them were pulse-meetings; during these meetings the project team gathered in order to get an update of what had happened in the project the last week and what was going to happen in the project in the near future. One of the meetings attended was a divergence meeting where divergences that had happened in the production were brought up. Finally, a product change order meetings was observed where any changes that had to be made with components were discussed. During the meetings people with different roles and from different departments was attending such as product coordinators, order planers, purchasers, production managers, R&D managers and project managers. It was between 10 and 15 people attending every meeting and each meeting was between 15 and 30 minutes long.

How much the researcher is interacting during the observation depends on the design of the research. However, the responsibilities the researcher has are to observe activities that would occur in the same way if the research was not participating, engaging in the activities in some way, interacting outside of a controlled research environment and identify key informants (Mack et al., 2005).

In the beginning of the observations it is good to have some topics and research questions in mind. In general the researcher should observe the following:

- Appearance – Clothing, age and physical appearance.
- Verbal behaviour and interactions – Who speaks with who.
- Physical behaviour and gestures - what people do and who does what.

(Mack et al., 2005)

In addition to this the researcher preferably sketch a map of the observation site (Mack et al., 2005). In this study, an observation chart was created with notes about what to look for so that the researcher would keep focus on the important topics.

The reason for choosing observations as a method for data collection was that it could give the researchers an opportunity to see if there were any differences between how the participants claimed they used the board during the interviews and how they actually used it during the observations. Furthermore, the observations provided the researcher with an understanding about how the people acted and interacted around the boards. The observations were also used in order to give the study additional credibility.

3.3   Data analysis

When performing a study in an abductive approach the researcher is going back and forth between the building of the theoretical framework, empirical findings and the data analysis (Dubois & Gadde, 2002). This approach has been used in this study, when the data was gathered an initial and very broad analysis was made. Dubois and Gadde (2002) argue that the reality should not be forced to fit with the preconceived categories of theory. Therefore, after the initial analysis of the data, the theoretical framework was complemented with the theories that the researchers felt fitting to the empirical findings. Thereafter the data was analysed again, this time more in depth than the first time.

In order to do this second more in depth data analysis Excel was used. Categories from the theoretical framework were written down in the rows and were matched with the different interviews and observation, which was written in the columns. In this way the researchers got a good overview of how the empirical data was matching the theory or if there were any mismatches. The empirical parts that were not able to be matched with the theoretical framework or was not covered by it were then written down and categorised in a Word document. When all the data has been categorised, it was analysed.

3.4   Reliability and validity

An alternative for reliability and validity in a qualitative study is the trustworthiness that was presented first by Lincoln and Guba. Trustworthiness consist of four different parts; credibility, transferability, dependability and confirmability (Bryman, 2012).

3.4.1   Credibility

Credibility is concerned with the finding out if the researcher's interpretation of the social world surrounding the interview participant is understood in the correct way. One way of making sure of credibility is to submit the findings of the report to the actors in the social world for confirmation (Bryman, 2012). This way of making sure of credibility has been used in this study.

3.4.2   Transferability

Transferability is concerned with either or not the result of the study is transferable to other context or organisations. Since qualitative research is often performed on a small group or individuals with certain characteristics, qualitative studies tend to be oriented around contextual uniqueness (Bryman, 2012). By describing the context in which the research has been conducted the transferability is left to the reader to interpret if the results are transferable or not.

3.4.3   Dependability

Dependability is about reliability, which describes how reliable the result of the study is. In a qualitative study it is about ensuring that complete records are kept during the study. This includes problem formulation, selection of research participants and interview transcripts (Bryman, 2012).

3.4.4   Confirmability

Confirmability is about objectivity. Total objectivity is however, impossible in social research. The researcher should be acting in good faith, which means that it should be apparent that the researcher has not let personal values and theoretical inclination affect the researcher during the study (Bryman, 2012). To ensure this the participants in the study have been handed the work for confirmation, this will make sure the researchers values have not affected the study.

3.5   Research ethics

Bryman (2012) present four different ethical aspects that have to be considered when carrying out a research study.
- Harm to participants
- Lack of informed consent
- Invasion of privacy
- If deception is involved

The harm of participants is concerned with the anonymity of the participants and that the researcher has to anticipate and guard against consequences of the research participants. In order to do so the researchers must make sure that the

participants are not identified or are identifiable when the findings from the research is presented. Lack of informed consent are concerned with that the research participants get enough information about the research that they are about to participate in so that they can take an informed decision in whether to take part of the research or not. The invasion of privacy aspects is closely related to this since it is concerned with that the privacy of the participant are not violated. The aspect of deception is when the researcher is presenting its research as something else than it is (Bryman, 2012).

The researcher has taken these aspects in consideration through sending the interviewees a description of the research before the interview along with the questions that the interviewees are supposed to answers. In this way they get a good understanding of what the research is about and can therefore take an informed decision of whether or not they want to participate in the study. Furthermore, both the participants and the companies participating in this study are made anonymous.

4   Case description

This study builds on two different case companies. In total seven people, four at what will be called company A and three at what will be called company B, with several different positions have been interviewed. Furthermore, five observations have been undertaken, three at company A and two at company B. The observations have been performed to get an understanding of how the personnel and the project manager are using the boards during the meetings and if there is a difference of what they are claiming that they are doing from the interviews and how they act during the meetings. The boards used by the two companies are presented, however due to confidential reasons the researcher was not allowed to take any picture on the boards used in the companies. Therefore, the boards presented below is created to give the reader an understanding of how the boards looked like.

4.1   Company A

Company A is a producer and developer of electronic solutions. They are working within two main areas, industry and automotive and have a turnover of approximately 340 million SEK and the number of employees reaches to about 130, which makes it a medium sized company. Company A would be what Whyte et al. (2008) calls a project-led organisation since the main operations is organised conventionally around a production line but are complemented with the research and development and the projects developing new technology.

The researcher has been looking into the R&D department where company A is developing products in project within the different areas, industry and automotive. The teams are consisting of different people from different department's e.g. different engineers and purchasers. The meetings that the researcher has been attending at Company A are held once a week in order to give frequent updates. The meetings are lasting for 15 to 30 min and there are about 15 people that are attending to each meeting. Participants at the meeting are employees from different departments.

Company A is working with visual boards in different ways e.g. when divergences appear, when something has to be changed with a component, to get an overview of the on-going projects and in production. The researcher has attended meetings regarding the first three occasions where visual boards have been used. The visual boards described below are built up with inspiration from lean principles. The meetings that were attended have been around different boards. However, all the meetings have been in the same room due to that the different boards are located there. The room where they are located in are a central room. The boards are placed on the walls and can therefore not be moved. In the middle of the room there is a big table. The boards are placed on both sides of the table. The room is also used for other internal meetings where the boards are not used.

4.1.1   Divergence meetings

During the divergence meetings divergences from the production that have appeared during the last week are brought up along with other divergences that

have appeared earlier. However, they cannot show all the divergences but they have to prioritise which divergences that are the most important ones.

"…we do not have all the divergences on the board but the ones we are working on right now."
Interviewee 5

It was mentioned that they had around 170 divergences now and obviously not all of these can be at the board. Only the divergences that are being taken care of is visualised at the board. The different divergences get a number that is unique for that specific divergence. Furthermore, the divergence gets a finish date and they are using colour coding to show the status of the divergence. They are using three different colours, green which means that it is under control, yellow that means that something has to be done and red that means that the divergence is critical. Moreover, the divergences are divided into groups, e.g. purchase, development and production, every group gets some emergent divergences and a person from that department responsible for the divergence. During these meetings there are about 10-15 persons attending. The participants are from the different departments concerned.

	Divergences	Created Date	Description of divergence	Ongoing investigation/ Planned action	Responsible	Planned finish date	Finish Date
Department 1	Divergence 1	Date		Activity	Göran	Date	
	Divergence 2	Date	(red)	Activity	Klas	(red)	
	Divergence 3	Date		Activity	Lasse	Date	
	Divergence 4	Date		Activity	Maja	Date	Date (green)
Department 2	Divergence 5				Kalle		
	Divergence 6				Kristina		
	Divergence 7	Date		Activity		Date	Date (green)
	Divergence 8						

Figure 2 Divergence Board

4.1.2   PCO (Product change order) meetings

During these meetings, changes in production and products are brought up, this could for example be that a component has to be changed due to that it has been out-dated. Then it becomes a product change order. The columns on the board are divided into the different departments. The PCO get allocated to a specific department and a specific person who will be responsible for that PCO. The status of the PCO is shown through the same colour coding system that is described in the divergence meeting section. During these meetings there are about 15 people attending from different departments, e.g. purchase, production and product coordination.

Product change orders	Department 1	Department 2	Department 3	Department 4	Finish Date
PCO 1					
PCO 2	 				
PCO 3		 			
PCO 4			 		
PCO 5				 	
PCO 6					
PCO 7					
PCO 8					
PCO 9					
PCO 10					
PCO 11					

Figure 3 Product Change Order - board

4.1.3   Pulse-meeting

During these meetings an overview of the different projects are presented. The projects are colour coded so that it is easy to see which of the areas, automotive and industry they belong to. The rows are divided into the different projects and post-its representing activities are put on the specific projects they belong to. The x-axis on the board is a timetable. This makes it possible to see when a specific activity should be done. Furthermore, the post-it are colour coded; each function has its own colour, which means that one can see which department that is responsible for the activity. If the activity has to be postponed, a dot is put on the note; this is to make sure that an activity is not postponed too many times. In addition to this board another board is also used, see **Fel! Det går inrte att hitta någon referenskälla.**. This board is divided into the different departments that are responsible for the different parts of the product and shows the status of each department. The status is shown through magnets in different colours. The colours are green, yellow and red where green means everything is fine, yellow means that measures have to be taken and red is that something is critical and has to be dealt with. The people attending to these meetings are project managers and product development managers from the different areas, automotive and industry. There are 10-15 people attending the meeting.

Projects	Timeline				
Project 1	Activitiy				
Project 2		Activitiy			
Project 3					
Project 4	Activitiy				
Project 5					
project 6					
project 7			Activitiy		
project 8					
project 9	Activitiy				
project 10					Activitiy
project 11					
project 12					
project 13					

Figure 4 Project Board 1

	Status	Project 1	Project 2	Project 3	Project 4
Department 1	■	Activity	Activity		Activity
Department 2	■		Activity	Activity	
Department 3	■	Activity	Activity		Activity
Department 4	■	Activity		Activity	
Department 5	■	Activity	Activity	Activity	Activity

Figure 5 Project Board 2

4.2 Company B

Company B is a producer and developer of access control systems, booking systems and entry phones in apartment buildings. They have a turnover of about 130 million SEK and the number of employees is around 60. This makes Company B a medium-size company. This company would also be considered a project-led company since its main operation is production but they have e.g. research and development for strategic purposes.

The room where the board is located is an open area in connection to an open office. There are two small round tables in the middle of the room where people can stand around. When the meeting begins the board is placed in front of these tables so that everyone can see it.

Company B are using visual boards during pulse-meetings. They have one pulse meeting for every project. The pulse meetings are held on different boards. The meeting that have been observed are about a new ERP-system that company B is implementing.

The rows of the board is divided into the different functions, each functions has its own row. The columns show processes, status, inbox, to-do and done. New activities that people come up with can be placed into the inbox column if the person that puts up the activity does not know which function to put the note on. In that case it is the project manager's responsibility to delegate the activity. The activity is written on a post-it and is then put up on the board. The process shows the different functions and the persons involved in the project from that function. The to-do column shows what that specific function has to do and the activities that are done are placed in the done column, this can be done by the project members themselves during the week. People can at any time put up new activities that they want to bring up to the next meeting. The status is using colour coding to show how it is going within the different processes. The colours used are green that means its fine, yellow that means that there are some troubles and red, which means there is something critical. The people attending to this meeting are the project manager, which is holding the meeting and the project members, which are from different functions and departments from the company e.g. purchase and product development. There are about 10 to 15 people in total attending. However, the meetings are open for everyone to come.

Process	Status	Inbox	Todo	Done
Department 1				
Department 2				
Department 3				
Department 4				
Department 5				
Department 6				
Department 7				

Figure 6 Project Board Company B

5 Findings

5.1 Benefits with visual boards

The benefit that was most commonly mentioned during the interviews was that the boards gave a clear overview of the current work. It was commonly stated that it was important that representatives from different units was attending the meetings so that they could get a holistic view of the work.

"*It gives a clear overview*"
Interviewee 3

"*You get a fast overview of the situation*"
Interviewee 4

Furthermore, the second most mentioned benefit of the boards was that they enable earlier problem identification. The interviewees had the impressions that the problems were revealed earlier and/or that the board could give an indication if problems would appear in the near future. This was due to the colour coded status magnets at company A and due to that it becomes apparent when a department have too many notes or activities on their row in company B. Both interviewees at company A and B said that they thought that people would not bring up problems as early as they appeared today when the boards are used. This is due to that it is not as natural to report problems by e.g. e-mailing 15 people as reporting them on the board. One interviewee at Company B indicated that people would probably wait a lot longer before asking for help when problems appeared. With the boards the problems could be dealt with earlier, which resulted in less chaotic problem solving.

"*The problems would have appeared in frustration without the board, the problems are recognised earlier now.*"
Interviewee 5

One of the contributing factors to the earlier problem identification was that people could not hide in the amount of work and that the reporting was more honest when using the boards and problems are brought to the surface. With the board, reporting becomes natural since one can see if an activity has been up on the board for a long time. The board with its simple structure seems to become a way of communicating with the different members in the group and also bringing transparency to the project so that everybody can see what is happening in the different function and where help is needed. In this way the boards created more openness and increased availability. Furthermore, the clashes in activities were easier to recognise using the boards according to interviewee 1. As can be seen earlier problem identification seems to be one perk with using the visual board. However, when it comes to the actual solving of the problem, it has been stated by several interviewees that this goes beyond the limitations of the board.

Frustration can also be reduced due to that people can see what is going on in the projects and which divergences is prioritised right now according to

Interviewee 5. Furthermore, that the divergences are up on the board make people calmer since they know approximately when they are going to be dealt with and that they are going to be dealt with. The meetings also made it possible for the group to respond to each other's problems. It has been stated by interviewees in both companies that people get an opportunity to respond to each other problems. However, it has also been stated in both company A and B that longer discussions that only concerns a limited amount of participants they should take that discussion outside of the meetings. However, these discussions might occur in meetings anyway. This seems to be more common during the meetings in company B compared to company A. During an observation at Company A such discussion broke out between two parties and then the one in charge of the meeting asked them to take that discussion outside of the meeting so that others not involved did not need to listen to that discussion. In Company B however, interviewee 7 mentioned that these discussion could break out during the meeting and that people had to listen to it.

The members' engagement to the work was increased with the boards, people gather around them and that creates a sense of team spirit, which brings the group together.

"We have many boards where people meet and that brings people together"
Interviewee 1

It was also mentioned by an interviewee at company B that the motivation for problem solving increased due to that a competitive feeling could be created around the boards and that everybody saw how much each member had done during the weeks. It was also mentioned at Company A that the boards had a pushing effect on the people due to the visualization. Moreover, motivation was also created by visualization since it made it clear when one had achieved something. This function of the board can also be used for manager to follow up on work and control how it progresses. This pushing effect drives efficiency since it has been stated that people feel embarrassed when they have not performed what they were supposed to. The boards and the meetings could create engagement in itself.

"… it creates team spirit and engagement"
Interviewee 7

A benefit that most of the interviewees brought up was the improved communication. The boards make the members talk more and one employee stated that there was more two-way communication now than before. Before the boards were used the communication was more flowing in one direction. Furthermore, the board become something to discuss around and the visualization enables the members to recognise what has been talked about before and what the different activities are all about. There is less need for the one in charge of the meeting to repeat the meaning of different activities. This was also seen from the observations where people used the boards to refer to different activities and clarify which activity they were talking about. The colour coding used on the boards was also referred to during the meetings so that

everybody knew the status of the activities. When gathering around the boards it forces people to communicate with each other. Furthermore, the communication has become faster and the boards also provide a way of making it clear what one means. This was also supported by the observations where people could have quick discussions about different activities and take decisions about progress for that specific activity directly at the meetings. Moreover, the information on the board is neutral and everybody gets the same information and the information is available for everyone. It has even been mentioned that the meetings around the board's works as communication channels between departments resulting in that people get a better holistic view of the organisation than before. Moreover, it has also been stated that people from different hierarchies meet around the board.

"All the small meetings around the boards serves as channels between the departments which are useful, these had not existed otherwise."
Interviewee 1

"The communication gets faster since everybody involved is attending the meeting"
Interviewee 4

The boards also give a better understanding between the different departments work and as has been stated above the boards work as channels between the different function. This also gives people an understanding of who knows what and enables people to draw boundaries between the departments to make it clearer who is responsible for what according to Interviewee 4. It has also been stated that dependencies between different meetings can be shown through the board. Furthermore, during the meetings people with different hierarchical positions meet. Not only the communication within the team has been stated as a benefit, one interviewee mentioned that since they started with the boards even the management board knows what is going on.

The boards could also be used for resource planning, the board's gives a good overview of what resources was available and which processes that needed more resources if they were struggling with a task for example, this was stated by several interviewees. Every task does not fit on the board, which demands prioritising of the activities that will be displayed on the boards. During the meetings observed there where common that the participants discussed the activities and which status and deadline they were supposed to give the different activities, which to give longer time and which to give shorter time etc.

"It gets clear if a process has a lot to do... then you have to act by for example adding more resources"
Interviewee 2

Interviewees at company B states that the board shows what activities are prioritised for the moment. Furthermore, during an observation at company A it was stated that they had to priorities what was on the boards since everything could not fit there.

It has been mentioned by several interviewees that the board assist as a support for remember what to talk about and what work is in progress. Moreover it could work as a reminder for other to bring up problems they have experienced, when they see the activities on the board they could be reminded of this.

5.2   Disadvantages with visual boards

Since the boards bring problem to the surface and also give a clear overview of the projects some people take a defensive position and it can create irritation within the group. It has been stated by several interviewees that people can feel embarrassed if they have not done what they were supposed to do and this is the reason that they take a defensive position. This could also decrease group cohesion.

"Some people takes a defensive position if they have not done what they was supposed to."
Interviewee 2

For a short time Company A had some problems with the boards. The project members could blame the board when they had not performed what they were supposed to. People could say that the activities were not on the board and therefore they did not have to do it.

"For a short time we had problems that people blamed the board for not being done, "that was not on the boards""
Interviewee 3

One negative aspect of the boards is that all activities are not on the boards; sometimes people are working with other activities, which makes it hard to follow up. As have been mentioned the boards provide an opportunity to respond to each other's problems. This can also be irritating since the one responsible might have tried most of the proposed solutions. Furthermore, it is also stated that the meetings take a lot of time. One interviewee states that it takes up around 10% of the total working time. Moreover, one disadvantage is that the boards cannot be used when a team is geographically dispersed.

"The disadvantage with whiteboards is if you have meetings on distance then a screen is better."
Interviewee 7

During one of the meetings at company B there was one participant that was joining the meeting through Skype and the computer that this participant was connected to was standing on the table in front of the board. However, this participant did not seem to be very active in the actual meeting.

5.3   Visual boards replaced by IT

Most of the interviewees believe that the visual boards can be replaced by an IT-solution. At the same time there are many of them that also say that the

simplicity that comes with the physical boards would be lost if they decided to change to an IT-solution.

"I think that the simplicity would be lost if the boards were replaced by an IT-tool"
Interviewee 1

Today's system with the board is simple and everybody participating in the meetings understands quickly how to use and change things at the board. If there would be a change to an IT-solution there had to be a part of it that was like moving physical objects. Company B has tried to use an IT-solution in form of a big touch screen. This screen however, was too complicated to work with. It is easier to write things on a physical board.

"We've tried to use a touch screen but that was too hard to use, it got to be simple to use and the problem is that people does not go and look at a screen in the same way as a board"
Interviewee 2

The positive aspects that the interviewees can see with changing to an IT-solution are that one could work and manipulate an IT-solution more freely. For example if a new row has to be added, one could do so. A physical board has its physical limitation when it comes to these kinds of things. Furthermore, the administrative work could be reduced by an IT-solution and information can be stored. Moreover, one interviewee thinks that it would be easier for people to find information about the project since it could be available everywhere while another thinks that people would not go and look at a screen as they do with the physical tools and therefore not get as much information from the projects as today. Additionally, with an IT-solution it would be easier to have meetings when people are sitting at different geographical locations.

"The disadvantage with whiteboards is that they do not work at distance"
Interviewee 7

However, every interviewee agreed on that an IT-solution would have had to have some sort of physical illustration to be connected to the IT-solution.

5.4 Other visualization methods used by project managers

The most mentioned visual tool that was mentioned during the interviews was the whiteboard. There were several ways that the interviewees described that the boards could be used at. They could be used for time planning, risk exercises and for group discussions. In combination with sticky notes it is particularly good since they can be moved around until a solution has been found. This way of working can also be used when building new processes or when planning activities for a project, team members can write down the activities that they have to do and then they can be put together to work packages. Furthermore, the whiteboards is good in brainstorming exercises. With a whiteboard one is forced to build up the message, building up the message in a systematic way

makes it understandable for the rest of the group. Drawing could also be used in order to explain things.

"Sometimes it can be hard to put words on what you mean, then it's good to draw"
Interviewee 2

"Whiteboards are a pretty underestimated tool"
Interviewee 7

Other tools used are fishbone-charts, this is good to use when one wants to find the root cause of a problem. Furthermore, several interviewees have mentioned the use of word, excel and power point as tools that is commonly used.

"All software that is used to show something on the screen can be used to communicate with each other no matter if it is Word, Excel or Power Point.
Interviewee 7

"Fishbone-charts to use in order to find the root-cause to a problem has been a good tool to use"
Interviewee 3

A screen also has been mentioned used for problem solving in groups, then the problem is displayed at the screen and the group can discuss the problem. Bar charts are also explained to be used to display the current situation and is something everybody understands. Processes can also be planned by visualization software; boxes are then created in the software and can be moved around.

5.5 Summary

To summaries the benefits and the disadvantages presented in this section a table has been created listing these. The benefits have been divided into two different categories, practical benefits and informal benefits.

Benefits		Disadvantages
Practical	**Informal**	
Overview	Improved engagement and motivation	Defensive position
Earlier problem identification	Better reporting	Blame the board
Improved communication	Drives efficiency	Time consuming
Easier resource planning	Better understanding for each other	Do not work on distance
	Decreased frustration	Irritation
	Simple to use	

Figure 7 Benefits and disadvantages with visual boards

6 Analysis and Discussion

In this chapter the empirical findings are analysed and discussed in comparison with the theoretical framework. It is divided into five different subsections that will help the reader to understand how the researcher has come up with the conclusions.

6.1 Benefits with visual boards

Lindlof and Soderberg (2011) and Parry and Turner (2006) argue that the most important feature of the visual boards are that the board gives the user an overview of what is going on in the project and the organisation. The results of the interviews are supporting this theory. All of the interviewees mentioned that the boards gave an overview of the work. This was the single most mentioned benefit. A common comment about the boards was that it gave a quick overview of the current situation and people was also saying that it was important that representatives from all the departments involved was there so that they could get a holistic view of what was going on. That the visual boards give a good overview seems to be a united opinion among the interviewees. Furthermore, the clear overview seems to be a precondition for other benefits that Lindlof and Soderberg (2011) mention. They claims that resource planning gets easier with visual boards due to frequent updates, which also makes the participants bring up problems in earlier phases. These benefits have been recognised during the interviews, only one of seven interviewees did not indicate that earlier identification of problems was a benefit of the visual board. The earlier problem identification can help project managers to deal with issues, risks and changes more efficiently since an earlier identification of a problem means more time to evaluate different solutions to the problem. When given more time to solve the problem one could argue that allocation of resources to solve the problem becomes easier for the project manager.

Furthermore, since the board is always updated and due to that in both company A and B it is clear how much each function in the project has to do, it also makes resource planning easier. Only four of the seven interviewees mentioned this as a benefit, however, these four interviewees were all managers and were responsible for this kind of task. This could be an explanation why the other interviewees did not indicate this as a benefit brought by the board.

Furthermore, Jaca et al. (2014) claims that the use of visualization makes recognition of rework and gaps in processes easier. The increased overview could be one reason that this also seems to be true for the companies that have been looked at in this study. An increased overview can reveal gaps and rework or clashes in activities. Moreover, it has also been stated that with the boards, there is more potential for honest reporting and that things are not hidden as before the boards were used, this makes problems and issues easier to detect i.e. what Jaca et al. (2014) claims seems to be true for both companies in this study. Easier recognition of problems also makes continuous improvements easier since the detection of problems is a basis for the problem to be solved and the processes to be improved. This is aligning with what Bititci et al. (2015) is describing as a benefit with visualization. For the project manager a natural

reporting and easier recognition of gaps and rework makes it easier for project managers to govern the project and to take action when needed.

Lindlof and Soderberg (2011) argue that visualization can be used to help managers to prioritise. The boards, that the different companies use, have been proved to be beneficial when it comes to prioritising. The boards used in Company A's divergence meetings for example is used to prioritise what divergences should be worked with. This has to do with the physical limitations that the board has, all the activities cannot fit on the board, which forces them to priorities. The physical limitation actually proves to be a benefit in this case. The board also shows how the activities are prioritised. Moreover, in Company B it has also been stated that the boards show what problems that are prioritised for the moment. Furthermore, the boards could also be used to prioritise where there is a need for resources and also which problems have to be prioritised.

Lindlof and Soderberg (2011) are describing that according to the lean principles the deeper discussions should be kept outside the meetings. It has been stated that this is the way it is supposed to be in both companies. However, it seems like it is more common that these discussion break out more often in Company B than in Company A. Since, Company A has built up their visual boards according to the lean principle that might be an explanation why they are stricter on keeping these discussions outside the meeting.

Bititci et al. (2015) describes that visualization can drive people engagement and to engage people in processes such as idea generation and strategic processes. This has been emphasised in interviews at both Company A and B. In Company B the boards were described to drive engagement in the project since it made it visual what they had to do and when they had completed a task. However, in Company A the engagement was more driven by meeting around the boards. This indicates that the board can drive motivation and create engagement in different ways. The board in itself with its structure, that people can see progress and that everything comes up to the surface can create engagement but the board could also indirectly create engagement since different members meet around the board and in this way get closer to each other. These ways of creating engagement has been mentioned in theory before. However, the findings from this study also indicate that the board can motivate people through creating a competitive situation since everyone can see who has done what. Due to this the team members are striving for having more activities in their "done" box, used at Company B, than the other team members. These effects are making the project more effective. Therefore, the board can support the project manager in leading and motivating the team.

According to theory, visual planning should increase the communication flow both in and outside the project. Moreover, it is supposed to increase cross-functional communication (Lindlof & Soderberg, 2011; Parry & Turner, 2006). This has clearly been the case in both Company A and B. It has also been stated that visualization can increase the speed and quality of knowledge transfer (Lindlof & Soderberg, 2011). This has been confirmed during the study. Interviewees have stated that visualization makes it clearer what one wants to

communicate and that the message that one wants to be delivered can be put up on the boards. Furthermore, the information on the boards has been claimed to be neutral and everyone gets the same information. Moreover, the information on the board is accessible and receivable and it can give a quick overview of the current situation. This indicates that the boards can be used in order to support the project manager in the task of creating efficient communication in the project team.

There are several communication challenges that visualization should be able to help overcoming. These challenges have been divided into three categories, cognitive, e.g. information overload, social, e.g. hierarchical communication challenges, emotional such as challenges with motivation (Eppler & Platts, 2009). The boards seem to be able to help overcoming some of the communication challenges in two of these three categories. The emotional challenges can be overcome since boards have been proved to increase motivation and can have a sort of pushing effect on the actors. Visualization has been proved to be a motivating factor and seen as some sort of reward when there is clearly stated when progress is made for example when post-its representing problems or activities has been taken down due to the activity is completed. As mentioned earlier it creates a sort of team spirit since people is meeting up around the board and sometimes has to solve problems together around the boards. Social challenges can be overcome since people from different hierarchies meet around the boards and everybody gets the same information. The boards become a communication tool between hierarchies since everybody can put up notes at them during the weeks if they locate a problem. These problems are then discussed during the meetings where people from different hierarchies are participating.

A community of practice is described by Wenger (2011) as a group of people who share a concern for something they do and learn how to make it better by regular interactions. Clearly a project group can be seen as such a community of practice since they have a common goal in the project and the group is interacting with each other regularly. Moreover, Wenger (2011) states that a community of practice enable participants to share knowledge with each other and that they are not restricted by formal structures and that they make connections with people across organisational and geographical boundaries. The visual boards seem to enable these advantages for the project team in the cases looked at in this research. Through the observations and the interviews, it has been apparent that the board gather people from different hierarchies and functions, which enable sharing of knowledge and information across boundaries. Furthermore, the interviewees have stated that the board provide a tool for easier communication and helps the sender of information to deliver meaning in a correct way to the receiver. This also indicates that the board helps the project team to share knowledge with one another. Moreover, as has been stated above the boards can be of help when overcoming several communications challenges that also help information sharing within the community and therefore enable the positive aspects that is brought with a community of practice described by Wenger (2011).

As can be seen several benefits that the visual board brings to the project is aligning with previous theory about visualization and visual planning. However, one benefit stated by several interviewees is that the board can be a support to remember what to bring up during the meetings, what was agreed during the meetings and what activities that are prioritised right now. Furthermore, it could also work as a reminder for the participants for the meeting to bring up things. When someone brings up a problem then people will be remembered that they want to bring up something as well. In this way more problems can be discussed and come up to the surface as well. This has not been mentioned by previous theory.

Function \ Benefits	Governance	Manage Risk, issues, changes	Resource planning	Leading and motivating	Knowledge Management	Communication
Overview	x	x	x			x
Earlier problem identification		x	x			
Improved communication						x
Easier resource planning			x			
Improved Motivation				x		
Natural reporting	x					
Drives efficiency				x		
Understanding for each other work					x	x
Decrease frustration				x		
Simple to use			x	x		

Figure 8 Benefits-Function Chart

6.2 Disadvantages with visual boards

A disadvantage with visual planning is that it could be interpreted as a way for the managers to control the team members (Lindlof & Soderberg, 2011). The pushing effect, through the competitive feeling, that the visual boards can have that was described in 6.1 can also have a negative effect in form of that the team members take a defensive position according to the interviewees. Since some things that were hidden before now are raised to the surface, problems can be revealed, this in combination with the transparency created with the boards can create irritation and that some people takes a defensive approach. This irritation can make the group to take distance from each other. This can obviously make the project managers work harder since it is not unlikely that when people take a defensive position they are less willing to communicate and share information within the team. Moreover, the project manager has an obligation of trying to keep the project members motivated throughout the project, if irritation is created within the team this task is likely to be harder for the project manager to fulfil.

Lindlof and Soderberg (2011) also describes that the visual planning have a disadvantage when it comes to global teams since they do not work during these conditions. This was also found in this study. This indicates that that the visual board is not a preferable tool to choose for the project manager team members are located at different locations.

The benefit described in the previous section, that the team members can react to each other's issues has also been described as a disadvantage. It has been described that when people is trying to help to solve a problem they might suggest a lot of solutions that the responsible already have tried which can create irritation. Furthermore, it has been pointed out that the different meetings can be time consuming. Company A has previously had a problem with that people tend to put the blame on the board if they had not done their task during the week. Then they could say things like "it was not on the board" etc. If people react in this way when using the board it could make it more difficult for the project manager to keep people motivated for the project.

One disadvantage mentioned by the interviewees that has not been mentioned by previous theory is the problems that can come with that the boards and the accessories used on the boards are physical. It has been mentioned by the interviewees that the post-its can fall down due to that the glue does not stick anymore and that they can fall down due to other reasons e.g. people is walking past the boards and people accidently make the post-its fall down.

Function / Disadvantage	Governance	Manage Risk, issues, changes	Resource planning	Leading and motivating	Knowledge Management	Communication
Defensive position	X			X	X	X
Blame the board	X			X		
Meeting take time				X		
Do not work on distance						X
Irritation				X		

Figure 9 Disadvantages - Function Chart

6.3 Visual boards as boundary objects

Carlile (2002) describe three different views of knowledge boundaries; syntactic, semantic and pragmatic. Syntactic boundaries describe that in order to share knowledge there have to be common ground to share this knowledge at. Departments have to agree on procedures on how to work together. Semantic boundaries describes how the different departments has to share a common meaning and understanding and pragmatic that is the hardest to overcome describes how the departments have to share a common interest to share knowledge (Carlile, 2002).

The visual boards seen in this study can work as a shared syntax since they provide every function involved with the same information. Everybody knows how it is used and where to find information about who is going to do what and what the status of that activity is. Furthermore, there is a shared understanding of what the different colour coding means. In this way the visual boards provides a simple way of transferring information.

The visual boards can also create a shared understanding, which is emphasized as necessary from a semantic point of view. Several interviewees have expressed that the boards enable information sharing as well as delivery and interpretation

of messages in a correct way. Furthermore, the boards provide knowledge about other departments' problems and in this way the departments can learn from each other. Sometimes it is the production that gets an understanding for the development and vice versa, sometimes the procurement department gets an understanding from the other departments. The boards also show the dependencies between the activities, which can create a shared understanding in the group.

The visual boards can also be used to overcome pragmatic boundaries. As Carlile (2002) describes; knowledge can be localised, embedded and invested in practice. Due to this it can sometimes be hard for individuals to change their view of knowledge in specific areas. The visual boards however, provide the team a forum where they can discuss and express their opinion about problems and due to that dependencies between the different actors can be seen they can learn from each other and each other's problem. This gives them an opportunity to take in new knowledge about the other departments but also to affect the other departments' knowledge to reach a common understanding about a situation or a problem.

A good boundary object has three important characteristics; they have to create a common language between the different functions, the different function need to be able to present what is at stake for them, which means that the dependencies between them has to be presented and the differences has to be able to be sort out. The latter characteristic means that all the functions involved have to be able to manipulate the boundary object (Carlile, 2002). The visual boards have all of the three characteristics described above. Interviewees have mentioned that the boards create a shared understanding of the situation and that everybody gets the same information. Furthermore, to talk about the problem around the boards gives a shared understanding and clashes in activities are shown. Moreover, since the boards are physical and are made up by post-it and magnets everybody can easily grasp how the tool work and therefore change the board.

Boundary objects and visualization can give an understanding of the organisations priorities since the organisation only visualise what is important for them. Furthermore, boundary objects can also be used as a reminder of the existence of a problem while a solution is worked on. Moreover, the boundary object can be used to bridge the work of the project and the organisation (Whyte et al., 2008). The situations observed in this study support this theory and can give an indication of what is prioritised due to physical limitations discussed in 6.1. Since there are representatives from different functions in the meetings they work as communication channels between the different functions. The pulse meetings are open for everyone to participate in which means that if there are people that is curious about how some specific project is proceeding they can be there and get an update or they can go and have a look at the board to see what is happening. In this way the boards can be seen as a bridge between the organisation and the project.

It has been shown that users prefer simple objects to mathematical complex ones. This is due to that they create a simple way of receiving information for managers and are flexible and can create conversation around them. Sometime a boundary object does not provide a common language but can reveal the boundaries for shared meaning (Spee & Jarzabkowski, 2009).

It has been stated that the use of the boards along with its simplicity; even the management can get a fast and clear overview of the current situation and therefore are updated about what is happening in the projects. As has been mentioned several times before discussion around the board take place and it can reveal dependencies and creates understanding for each other. At the same time it can bring people closer to each other. Moreover, it has been mentioned that even if the different department do not get closer to each other they can divide the work between them and decide who has responsibility for what.

6.4 Visual boards replaced by IT

Olofsson et al. (2007) describes how implementing IT visualization has been beneficial in a number of ways. In their case study the benefits were that less time was spent on administration, less time was spent on non-value adding work and firefighting. Furthermore, problems appeared earlier and less rework had to be done.

In this study all the participants agreed on that the visual board could be replaced by an IT-solution in the future. However, most of them also recognise benefits with having physical tools as well. As is described above, one of the benefits the interviewees could see was that an IT-system could reduce the amount of administration. The use of an IT-tool could also enable storage of information that a physical tool cannot. The use of an IT-tool would also enable meetings on distance in more convenient ways than today. During one of the meetings there was one member that was attending the meeting on Skype. This kind of participants would have gained a better understanding of what is happening on the board by using IT. Moreover, an IT-tool can be more flexible than the physical board. More information could be presented. However, even though these advantages are recognised there are many of the participants that think that the simplicity of the boards would be lost. Furthermore, a common understanding is that the physical boards are appealing. A room with whiteboards are also available in a way that an IT-system is not.

Even though replacing the visual boards with an IT-tool could bring a lot of advantages, it seems like there are some barriers to overcome to replace them in practice. From the interviews it seems like people behave in a certain way around physical boards. The feeling that the physical boards bring to the participants in the meeting and the simplicity with which it is used has to be brought into the IT-tool. Furthermore, as it has been stated above the physical limitations of the board can have a positive effect as well. Furthermore, since the boards are physical people actually have to meet physically around the boards in that specific meeting room which brings people together. The board also works in the same way all the time and everybody can understand and know how to use them. This is also something to consider if replacing the physical tool with an IT-tool.

6.5 The role of visual boards for the project manager

What has become apparent from the findings is that the role the visual boards have for a project manager can be divided into two different categories, a practical and a social.

6.5.1 Practical

On the one hand it helps the project manager with the practical tasks such as planning of resources, improve communication and to govern the project as has been described in 6.1. This first category comes from the actual structure of the board. The information about who is doing what until which time can be easily read from the board. Furthermore, status from the board can be read from the boards and the resources that are allocated to the activities. Due to this the boards supports the project manager in governing the project. Furthermore, more honest reporting is supporting the project manager in its task to govern the project and to take necessary action for the project to be successful. In turn, resource planning, issues, risks and changes can be handled more efficiently. What is important to emphasize is that these benefits seems to be made possible due to the structure of the board, that the board gives a clear overview of the project and that the weekly meetings makes people report what they have done during the week. The clear overview also helps the project manager in communicating with the team since the information is available for everyone and that the need for repetition of different activities content seems to decrease.

The most important benefit for the practical factors is that the board gives the project manager a clear overview of the situation. This benefits seems to be a precondition for other benefits such as earlier problem identification, continues improvements, resource planning and identification of e.g. clashes in activities. This is due to that things cannot be hidden as work without the board. Activities are up there for everyone to see. Therefore, it becomes apparent when a function has too much to do and therefore needs more resources and if there is a clash in activities that is made explicit through the boards.

Function / Benefits	Governance	Manage Risk, issues, changes	Resource planning	Leading and motivating	Knowledge Management	Communication
Overview	x	x	x			x
Earlier problem identification		x	x			
Improved communication						x
Easier resource planning			x			
Natural reporting	x					

Figure 10 Practical benefits

6.5.2 Social

On the other hand the visual board helps the project manager with more social practices. It can increase motivation (read more about this in 6.1), make the participants learn more about each other's roles and give a better understanding for the other functions in the group (read more about this in 6.3). Having meetings around the boards create more team spirit and makes the group come closer each other. This second category is revealed when the board is used as a

boundary object. It brings people together and forces them to communicate with each other. Moreover, this makes the participants develop a shared understanding and a shared meaning of what is talked about.

The most important benefit for the social factors seems to be the simplicity of the board. The simplicity of the board makes people from different departments to gather around it. Moreover, the simplicity of the board makes everybody understand and interpret the information easily, which can create cohesion and discussion in the group. Furthermore, it creates a shared meaning and also makes it possible for everyone to change, add and remove things on the board. Read more about this in 6.3.

Function / Benefits	Governance	Manage Risk, issues, changes	Resource planning	Leading and motivating	Knowledge Management	Communication
Improved Motivation				X		
Drives efficiency				X		
Understanding for each other work					X	X
Decrease frustration				X		
Simple to use			X	X		

Figure 11 Social benefits

7   Conclusion

What can be concluded by this study is that even if the visual boards is a simple and mundane tool it still highly relevant for the project manager. It supports the project manager in a number of different ways and by study it one can get an understanding of what project management is all about. This first part is structured around the research questions.

What is the role of the visual board for the project manager?
The role of the visual boards for project manager can be divided into two different categories, a practical one and a social one. The practical category helps the project manager with the planning of resources, the communication and to govern the project. The social category is when the visual board is used as a boundary object. Then the board serves to help the project manager to create engagement and motivation in the team. Furthermore, the board helps the participant to develop a better understanding for each other's work. Moreover, whiteboards seem to play an important role in the project manager's work during different tasks such as brainstorming and problem solving.

What are the benfits of the visual board and how is it used today?
There are two main benefits of the board; the first was that it gives a clear overview of the current situation. The other is the simplicity of the board, which enables everybody to interact around the board, to use it and to interpret it. The overview is important for the more practical parts such as the earlier problem identification and the planning of resources. The simplicity however, is the most important for the social parts where the board is used as a boundary object since it enables the participants to interact around the board, use it and interpret the content of it.

Can the board be replaced by in the near future?
The visual boards can be replaced by an IT-solution. However, this sets requirements on the IT-tool to work as simply as the physical tool so that it will be natural for all the participants to work with it. There are however some benefits with the physical limitations of the board. The value of these limitations has to be considered before changing from a physical tool to an IT-solution.

7.1 Lessons learned

What was successful with this study was that interviews and observations could be performed in two different companies and people from different departments were interviewed which gave different perspectives. Furthermore, the use of both interviews and observations was a successful combination since things that was brought up during the interviews was also seen during the observations, which increased the trustworthiness of the study. However, the interviews were held with very little time in between them. If more time could have been gained between the interviews and the between the observation changes to both the observations chart and the interview guide could have been made. This could have resulted in that even more useful data would be gathered during the observations and the interviews. Since it was the first time for the researcher to use observations as a data collection method it was a bit overwhelming with all

the information that came out from these. To improve the observations, the observation chart could have been developed even more specific which could have helped the researcher to sort out what was useful information and what was not during the meetings.

7.2 Limitations and further research

This research has looked at one type of industry and two companies in that industry. For further research, in order to increase generalizability of the results of this research it would be interesting to look into different kinds of industry to see if there are discrepancies or variations. Moreover, in order to make the result more generalizable for the industry looked at in this research more companies could be studied. One research question is concerned with whether the visual boards can be replaced by an IT-solution; in order to answer this question, the researcher used interviews. In order to deepen the knowledge about replacing the board with an IT-solution other research methods could be used such as observations and simulations.

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ANNEX 1 - Interview questions

How do visualisation support you when conveying a message to the group? In what way?
Hur stödjer visualisering dig när du försöker förmedla ett budskap till gruppen? På vilket sätt?

How do you use visual tools to communicate with people with different professions?
Hur används visualiseringsverktyg för att kommunicera med folk med olika yrken?

How do you use visualisation to understand information? When? To which purpose?
Hur använder du visualisering för att förstå information? När? För vilket syfte?

How do you use visualisation when talking to people from different departments?
Hur används visualisering vid samtal med personal från olika avdelnigar?

How do you use the visualisations boards/tools outside the meetings? Why? When?
 Hur använder du visualiseringstavlor/visualiseringsverktyg utanför mötet? Varför? När?

Has visualisation helped you to identify issues? How? When?
Har visualisering hjälpt dig att identifiera problem? På vilket sätt? När?

How do the visual boards affect the communication between different participants?
Hur påverkar visualiseringstavlor kommunikationen mellan olika deltagare?

What role do you think bringing in anecdotes has for reaching the project goal?
Vilken roll tror du att anekdoter har för att nå projekt målet?

How does visual board promote problem solving in the project?
Hur främjar visualiseringstavlor problemslösning i projekt?

Do you think that the use of visual tools is bringing people in the group together?
Tror du att användandet av visualiseringsverktyg för deltagarna i gruppen samman?

What if you did not have the visual tool?
Hur tror du det hade sett ut om inte visualiseringstavlor fanns?

Could an IT tool replace the visual tool?
Skulle visualiseringstavlor kunna bli ersatta av en IT-lösning?