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A Case Study at a Technical Consultancy Firm

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

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ABSTRACT

Using team members in different geographical locations has become more common as technological improvements have increased the possibilities for virtual collaboration. The use of hybrid teams has become more practiced in the infrastructure and construction industry as different competencies are found in different organisations and locations. As organisations have realized the benefits of Concurrent Engineering it has become a more used method in the sector. The *Purpose* of this research is therefore to examine the role of the Project design manager in hybrid project teams applying Concurrent Engineering. The aim is to identify challenges faced by the Project design manager when managing hybrid project teams. Further, as the methodology of Concurrent Engineering is to create an interactive environment where team members contribute with their individual competencies, the study investigates how this affects the role of the Project design manager. The *Method* consist of a qualitative research design where a case study has been performed on an infrastructure project at a technical consultancy firm. Ten semi-structured interviews with project participants and a participant observation during a Concurrent Engineering session have been performed. *Empirical findings* show that the Project design manager in hybrid project teams face challenges in terms of communicating with dispersed team members, establishing cohesion and establishing technical prerequisites. The *Conclusions* drawn from the study, show that the Project design manager is a facilitating role and serves as a process leader when managing hybrid project teams applying Concurrent Engineering. The role of the Project design manager is to actively distribute the word during Concurrent Engineering sessions but also to establish cohesion and efficient communication. *Recommendations* suggest that the Project design manager focus on creating an interactive environment where all participants are comfortable in sharing knowledge with the project team.

Key words: Project design manager, Project management, hybrid project team, Concurrent Engineering, communication, cohesion, trust, facilitator, process leader.

Projekteringsledarens roll i hybrida team där samtida projektering tillämpas
En fallstudie på ett infrastrukturprojekt vid ett teknikkonsultbolag

Examensarbete inom masterprogrammet International Project Management and Project Management

LINA OLSSON
Institutionen för bygg- och miljöteknik
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SAMMANFATTNING

Användandet av geografiskt spridda teammedlemmar har blivit allt mer förekommande inom byggsektorn i takt med utvecklingen av tekniska kommunikationsverktyg. Även hybrida team har blivit allt mer förekommande inom byggindustrin då kompetenser återfinns bland olika företag och platser. Då organisationer har sett fördelar med samtida projektering har detta blivit en applicerad metodik inom sektorn. *Syftet* med studien är att utreda projekteringsledarrollen i hybrida team där samtida projektering tillämpas. Målet är att identifiera svårigheter som projekteringsledaren ställs inför vid ledning av denna typ av projektteam. Eftersom samtida projektering inkluderar en interaktiv miljö där teammedlemmar bidrar med sin individuella kompetens ämnar studien utreda hur detta påverkar projekteringsledarrollen. *Metoden* som tillämpas består av en kvalitativ studie där en fallstudie har genomförts på ett infrastrukturprojekt vid ett teknikkonsultbolag. Tio semi-strukturerade intervjuer med projektmedlemmar och en deltagande observation under ett samtida projekteringsmöte har genomförts. *Resultatet* visar att projekteringsledaren i hybrida projektteam ställs inför svårigheter i att kommunicera med spridda teammedlemmar, skapa sammanhållning och skapa tekniska förutsättningar. *Slutsatserna* från studien visar att vid ledning av hybrida projekt team där samtida projektering tillämpas är projekteringsledarrollen en diskussions- och processledande roll. Rollen som projekteringsledare är att aktivt fördela ordet vid samtida projekteringsmöten samt ansvara för att skapa sammanhållning och effektiv kommunikation. I studiens *rekommendationer* föreslås att projekteringsledaren fokuserar på att skapa en interaktiv miljö där samtliga deltagare är bekväma i att samverka och bidra med sin kunskap till projektet.

Nyckelord: Projekteringsledare, projektledning, hybrida projekt team, samtida projektering, kommunikation, sammanhållning, tillit, diskussionsledare, processledare.

Contents

Preface

This study has been performed in fulfilment of the dual award MSc Program International Project management at Chalmers University of Technology in Sweden and Project Management at Northumbria University in UK. The research has been performed between January and June 2016. The study was motivated by the need for an understanding regarding the role of the Project design manager in hybrid project teams applying Concurrent Engineering. As organisations have realized benefits with the methodology of Concurrent Engineering it is of interest to examine how this affect the role of the Project design manager.

I would sincerely like to thank those of you who in some way have contributed to the conduct of this research. First, I would like to thank my supervisor at Chalmers University of Technology Petra Bosch-Sijtsema. Your knowledge and contribution has been a huge support in completing this thesis. Second, I would especially like to thank my supervisor J but also her colleague M at the Consultancy firm where the case study was conducted. You have not only been a support in guiding me in the right directions but you have also contributed with encouragement during the research process. I really appreciate your engagement.

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My opponent Rickard Andersson at the MSc program International Project Management at Chalmers University has been a valuable support. I really appreciate our discussions and laughter during the writing of the dissertation.

To my family and friends, your encouragement and support is worth more than I can express in this report.

Gothenburg, June 2016

Lina Olsson

List of Figures

Glossary

Assignment manager - Uppdragsledare

APM Body of Knowledge - Association for Project Management Body of Knowledge

BIM - Byggnads information modellering

Constructability support - Byggbarhetsstöd

Cohesion - Sammanhållning

Concurrent Engineering - Samtida projektering

Facilitator - Diskussionsledare

Hybrid team - Team bestående av både samlokaliserade och distribuerade medlemmar

Partial Project - Delområde/delprojekt

PMI - Project Management Institute

Project design manager - Projekteringsledare

Process leader - Processledare

Project manager - Projektledare

VDC - Virtual Design and Construction

Virtual team - Team med distribuerade medlemmar där kommunikation sker virtuellt

1 Introduction

The aim of this chapter is to outline the purpose of the research. The background and the theoretical rationale motivating the study are presented as well as the research aim and the context of the dissertation organisation. Further, the research scope, limitations and the research methodology are presented. The chapter also includes a brief description regarding the structure of the report.

1.1 Background

Building teams with different expertise have been the traditional way of working in infrastructure and construction projects. As these projects become more complex there is an increasing need of special expertise among project participants (Dossick, et al., 2010). This has led to subdivisions in the design phase of construction projects, where separate activities are managed by one or more experts. This means that a successful project does not only depend on the expertise among the project participants but on the collaboration between participants (Garcia, et al., 2004). In this manner, "Diversification in turn requires communication, collaboration, and coordination between specialized trades." (Dossick, et al., 2010, p. 459).

The development of technology has created conditions of using expertise situated in different geographical locations. A combination of both co-located and dispersed team members create a hybrid team. There are several researches studying challenges with virtual project teams. However, these often assume that there are no face-to-face interactions within the team, leading to that there is less known about hybrid project teams (Cousins, et al., 2007). In addition, organisations today often use different consultants who contribute to the project based on their individual knowledge and skills. Also, it is common that team members are participating in several projects at a time and this adds additional challenges to the project management of a hybrid project team (Nydegger & Nydegger, 2010).

In the design phase of a construction or infrastructure project there are several types of expertise needed. In that regard, the role of the Project design manager, the person responsible for this phase of the project, needs to manage the different competencies within the project team (Nordstrand, 2008). Also, the design process of construction projects often includes several participants such as different stakeholders, clients and corporate promoters. Meaning that there is a consistent exchange of knowledge and information between the project participants. However, communication and knowledge transfer in the design planning phase of a construction project is often seen as a difficulty. Further, interaction between project members and project stakeholders is considered as a key success factor in the design process of a construction project (Bosch-Sijtsema & Henriksson, 2014).

In order to promote interaction, organisations have realized benefits of Concurrent Engineering, which aims to gather team members during a focused meeting where issues are to be solved collectively during a limited timeframe, e.g. meeting or day (Chachere, et al., 2004). A research performed by Dossick et al. (2010) shows that when working jointly to solve a project there is a need of an inspirational leader who can navigate the project team and contribute to knowledge sharing. Utilizing Concurrent Engineering means that issues are managed collectively compared to sequential Engineering where meetings are held and afterwards team members solve

questions by themselves before the next meeting (Chachere, et al., 2004). As effective collaboration between project participants is considered as a key factor in performing projects on time and within budget (Hatem, et al., 2012), it becomes essential to study the role of the Project design manager when managing a hybrid project team applying Concurrent Engineering.

1.2 Theoretical rationale

Previous research of virtual teams often assumes there is limited or no amount of face-to-face communication (Cousins, et al., 2007; Fiol and O'Connor, 2005), leading to poor knowledge about hybrid teams. Further, Cousins et al. (2007) claim that hybrid project teams will face challenges that are not applicable on either pure virtual or co-located teams. A review of identified challenges in hybrid teams indicated challenges such as identification (Fiol & O'Connor, 2005) but also decision making (Maznevski & Chudoba, 2000). In addition, challenges connected to virtual teams can be added such as trust, communication, cohesion and motivation (Cascio, 2000; Senaratne & Samaraweera, 2015; Fiol & O'Connor, 2005; Verburg, et al., 2013; Nydegger and Nydegger, 2010).

A review by Sheard and Kakabadse (2004) shows that when operating in the initial phases' of a construction project the factors; communication, group dynamics and leadership differentiate an effective team from a loose group. Also it was found in a research performed by Bosch-Sijtsema and Henriksson (2014) that interaction between project participants and stakeholders in the initial stages of a construction project is considered as a key success factor. However, further research is suggested regarding the changing role of the project leader when adopting a more integrated work process, which motivates this study.

Also, as identified in APM Body of Knowledge, "projects are delivered by people and the dynamics, attitudes and relationships between those people are the key enablers to successful projects" (Association for Project Management, 2012, p. 50). This put demand on the Project design manager which has to lead the team and contribute to create a successful delivery of the project. In previous research by Cascio (2000) trust was identified as important in order for project participants to enjoy work and feel part of the team, meaning that it is essential to study if this is a challenge in hybrid teams.

Because of the absence of literature emphasizing hybrid project teams (Cousins, et al., 2007) and how to manage teams in Concurrent Engineering sessions, the theoretical rational to carry out the study can be justified.

1.3 Research aim and research questions

The aim of the research is to study the role of the Project design manager in hybrid project teams applying Concurrent Engineering. The research question of the study is as follows;

What is the role of the Project design manager in hybrid project teams applying Concurrent Engineering?

Supporting questions to answer the main research question;

RQ1 - What are the advantages and challenges with Concurrent Engineering?

RQ2 - What are the challenges for the Project design manager in hybrid project teams?

RQ3 - In what way has Concurrent Engineering changed the role of the Project design manager?

1.4 The context of the dissertation organization

The organisation in which this study has been performed is a technical consultancy firm, placed in Sweden. The studied project is carried out during the design phase which motivates the focus on the Project design manager whom has the responsibility for the delivery of this phase of the project together with the Assignment manager at the Consultancy firm. A further presentation of the case included in the study is being presented more detailed in Chapter 4.

1.5 Research scope and limitations

In the report the term Project design manager (PDM) is used for the person responsible for the design phase of a construction project. In a smaller project, the Project manager has the responsibilities of a Project design manager (Nordstrand, 2008) and thereby the research findings can also be applied to a Project manager leading hybrid project teams applying Concurrent Engineering.

The study does not address challenges often connected to virtual teams such as cultural differences, diversity and time zones.

The research considers challenges for the Project design manager in hybrid project teams and Concurrent Engineering. Meaning that additional interpersonal skills of the Project manager suggested in Project Management literature are not being covered.

In the report, the word Concurrent Engineering is being used even though the organisation in which the study has been performed use the term of Integrated Concurrent Engineering. However, the concept is the same as Integrated Concurrent Engineering and Extreme Collaboration where the aim is to gather team members in an interactive environment and work jointly on the project.

1.6 Research methodology

The social research design of the study is a qualitative approach where the theoretical framework has been based on the key terms; hybrid teams, project management, Project design manager, Concurrent Engineering and group dynamics. Theory was chosen based on the relevance when managing a hybrid team applying Concurrent Engineering.

The empirical data of the study was obtained through a case study of a hybrid project team at a technical consultancy firm. Data was gather by semi-structured interviews with team members and Project design managers. Also a participant observation with focus on the Project design manager was performed during a Concurrent Engineering session.

1.7 Structure of the thesis

In the second chapter the theoretical frame of reference is presented. This include characteristics of a temporary project team and hybrid teams. Also, face-to-face and pure virtual teams are examined as a hybrid team is a combination of both. The role of the Project design manager is investigated in terms of challenges faced when managing a hybrid project team. Lastly, the chapter presents the concept of Concurrent Engineering.

The third chapter focus on the methodology of the research performed. The chapter includes the research strategy, data collection method and research ethics.

Chapter four provides a brief case description. The objective with this chapter is to create an overview on the project team examined in the case study. This includes a broad description of the project and the team members included in the interviews.

In the fifth chapter the empirical findings from the interviews and the participant observation is presented.

In chapter six the empirical findings are discussed in relation to the theoretical frame of reference.

Chapter seven includes the final conclusions but also a reflection of limitations in the study. Further, suggestions for further research are presented.

In chapter eight recommendations of practical implications are presented.

2 Theoretical Frame of Reference

The aim of this chapter is to present the theoretical frame of reference used in the study. This includes the characteristics of hybrid teams, project management, managing hybrid project teams and Concurrent Engineering.

2.1 Temporary project teams

Due to the shifting needs of competence within projects as well as the improvement in technology, there has been an increased use of temporary project teams in organisations. These teams are designed based on competence needed in the specific project and since technology has enabled teams to collaborate, the use of virtual work settings have increased (Verburg, et al., 2013). Like permanent teams, a temporary project team needs to create relationships and determine methods for setting goals. This is claimed by Dyer et al. (2013), also suggesting that the team must set methods for how to solve problems, make decisions, create efficient communication but also to create a comfortable environment where people feel accepted. Further, the key to success lies within upfront planning but also sharing of expectations on the project. Some of the characteristics of effective teams proposed by Pinto (2013) is considered as a high level of trust, cohesiveness, a shared sense of enthusiasm and a result driven orientation. One advantage with the temporary project team is that there are no previous routines in terms of procedures on how to collaborate. However, this can also be a challenge in terms of the uncertainty regarding how to define roles and responsibilities within the project team (Dyer, et al., 2013).

2.1.1 Hybrid teams

Hybrid project teams are considered as the most common type of virtual teams (Lee, 2014). There are several researchers studying challenges and advantages of virtual project teams. However, these studies often assume that there is no face-to-face interaction meaning that there is less knowledge regarding hybrid project teams where there is face-to-face interaction to some extent. Using teams where some team members are located at different geographical locations has been more common during the recent years, mainly as a result of the development of information technology. This combination of pure virtual and co-located teams collaborate with both face-to-face communication and through computer mediated interaction (Cousins, et al., 2007). This becomes a challenge to the Project manager that needs to manage both traditional co-located members and virtual members (Lee, 2014). Challenges identified in previous researches is considered as managing conflicts, making decisions and transferring organisational knowledge. Two main ways of addressing these challenges are information technology that contribute to the communication between the team members. The other solution is establishing more frequent face-to-face meeting with the hybrid project team. However, this decrease the virtual degree within the project team (Cousins, et al., 2007).

2.1.2 Face-to-face teams

Face-to-face teams are teams which are often co-located. Meaning that they are operating at the same geographical location (Fiol & O'Connor, 2005). One of the main advantages of co-located teams is communication. Communicating face-to-face does not only involve the spoken language but also non verbal cues such as body language and facial expressions. This enables a basis for understanding compared to pure text-based communication (Lantz, 2001). There is also a higher level of identification with the team when working in face-to-face teams compared to virtual teams (Lind, 2007). Even though there are advantages with co-located teams, Levi (2007) argues that there is a risk of decisions taken that fits with the group. In other words, there is a risk that decisions are taken in order to maintain relationships in the group, instead of reaching decisions that are objective.

2.1.3 Virtual teams

Given the development of new communication technologies the possibility to communicate virtually has increased and therefore also performing project with virtual teams (Purvanova & Bono, 2009). In contrast to face-to-face teams, these teams are often characterized with the relative high absence of face-to-face interaction (Fiol & O'Connor, 2005). Further, Lau (2004, p. 737) defines a virtual team as "a group of people using electronics means to communicate with each other more often than face-to-face meetings". There are several suggestions of how to define virtual themes and as the one proposed by Lau (2004) some common themes are the low level of face-to-face interaction and the geographical dispersion of team members. This creates new challenges for the Project manager, who has to manage teams where participants are placed in different locations. Meaning that the Project manager must be capable of "maintaining respect, promoting the project vision, seeing goals, and enabling team member accountability for a geographically dispersed group..." (Lee, 2014, p. 10). In order to achieve this, Malhotra et al. (2007) have identified six behaviours of successful virtual leaders;

- Establish trust
- Ensure that team members feel understood and appreciated
- Manage virtual meetings
- Monitor team progress
- Enhance the external visibility of team members
- Ensure that individuals benefit from their participation in virtual teams

When comparing virtual teams with face-to-face teams there are three main differences such as; greater reliance on technology as a vehicle for communication, greater diversity in work norms and expectations but also greater demands on the team leader (Dyer, et al., 2013). A key component in efficient teams is considered to be trust which can become a challenge in virtual teams (Senaratne & Samaraweera, 2015). Previous studies have identified difficulties in establishing trust within virtual teams where no prior relationship exists between the team members (Cousins, et al., 2007). Since trust is considered to affect performance, especially when tasks within the project are highly interdependent, this becomes important to establish within the project team (Robert, 2009). Even though trust is considered as a difficulty, "swift trust" have been identified within virtual teams. This form of trust is based upon the role-based reputation among the team members and is often most common in the

initial stages of a project (Gardiner, et al., 2004). In Figure 1 below, a summary of advantages and challenges in pure virtual, face-to-face and hybrid project teams are presented.

	ADVANTAGES	CHALLENGES
PURE VIRTUAL TEAMS	Team members are chosen based on their individual competence instead of their geographic location	Communication Identification with the team Establish Trust Motivation
FACE-TO-FACE TEAMS	Improved communication between team members Easier to establish trust Identification with the team	A risk of decisions taken in order to maintain good relations in the group instead of reaching objective decisions
HYBRID TEAMS	Team members chosen based on their individual competence Communication between team members	Communicating with dispersed team members Identification with the team Establish Trust

Figure 1: Summary of advantages and challenges in pure virtual, face-to-face and hybrid project teams

2.2 The Role of the Project Manager

The Project manager is the person who is assigned as responsible for a project and ensures that the project objectives are being met (Project Management Institute, 2013). Common characteristics of a project is the complexity, the unique nature and the limited timeframe during which the project has to be delivered. This means that the role of a Project manager is often more complex than the one of a functional manager as every project is unique (Anantatmula, 2010). In the Project Management Body of Knowledge (2013, p. 5) project management is defined as "the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements".

The main responsibilities of the Project manager are often suggested as the managerial aspects such as time, cost and performance. However, the role of the Project manager goes beyond these aspects as projects are delivered by people. It is claimed in the APM Body of Knowledge that projects are delivered by people and "the dynamics, attitudes and relationships between those people are the key enablers to successful projects" (Association for Project Management, 2012, p. 50). Purport that the Project manager needs interpersonal skills that can address challenges in the project teams. Project Management Institute (2013) suggests essential interpersonal skills of the Project manager such as communication, decision-making, trust building, motivation, leadership and team building. Further, in a research performed by Anantatmula (2010) people-related factors contributing to project success were identified and these needs to be addressed by the Project manager as they are related to project performance. The factors proposed by Anantatmula (2010, p. 16) are;

- Create clarity in communication

- Define roles and responsibilities
- Communicate expectations
- Employ consistent processes
- Establish trust
- Facilitate support
- Mange outcomes

2.2.1 Design Management

In major construction and infrastructure projects it is common to use a person responsible for the project design planning phase, a Project design manager. This person is responsible for the planning and coordination during the design phase of the project. As a construction project involves several disciplines different competencies are needed among the project team. Meaning that the project team, in which the Project design manager is responsible for the design phase, there are also several participants involved (Nordstrand, 2008). This means that Design management is concerned with both process and people management. The person responsible for the Design management needs technical knowledge but is also required to have both project management, leadership and communication skills (Eynon & CIOB, 2013). Further, Design management is considered as teamwork with several participants who needs to have a close collaboration during the entire process. In order to deliver technical solutions, coordination between the project participants is essential and this requires administrative routines, carefully prepared communication systems but also well planned meetings (Nordstrand, 2008). In Figure 2 below, the Design management process is illustrated in combination with the Construction project lifecycle.

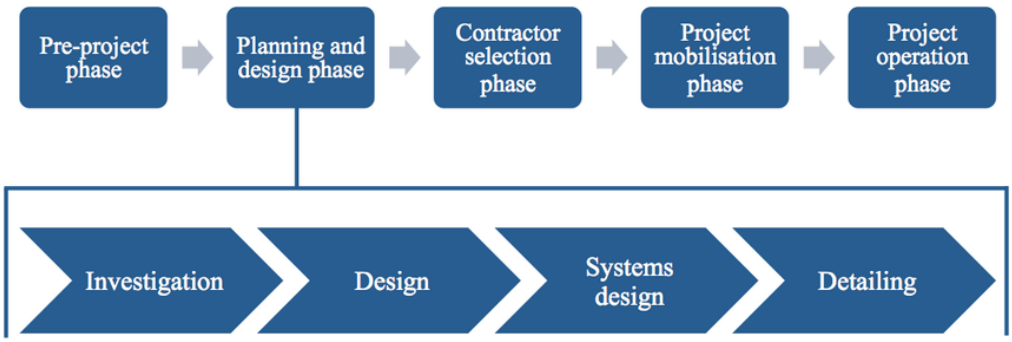

Figure 2: Construction project lifecycle (Bennett, 2003) and the Design management process (Nordstrand, 2008)

During the design phase of a project, interaction between different project participants and stakeholders is considered as an important component according to Bosch-Sijtsema and Henriksson (2014). Further, as the Project design manager is operating in the early stages of a project it becomes important to understand which factors that are crucial in this phase of the project process. In 1965 Tuckman proposed a model that identified four main phases of a team development process; forming, storming, norming and performing (Tuckman, 1965). The model is built upon teams where the members of the team are consistent. This is often not the case in construction projects where team members are different throughout the entre project lifecycle as there are

different competencies needed. However, the model proposes an understanding regarding different obstacles the team will face in terms of team performance (Sheard & Kakabadse, 2004). In the study performed by Sheard and Kakabadse (2004) key factors differentiating an efficient team from a loose group was identified in each of the phases proposed by Tuckman (1965). The results from the study indicated that during the forming and storming phases communication, group dynamics and leadership where identified as key factors for development. Meaning that the Project manager has an important role in terms of establishing well-functioning group dynamics including an efficient communication already in the initial stages of the project (Sheard & Kakabadse, 2004).

2.2.2 Manage the hybrid project team

One of the main components in project management is leading and motivating the project team (Association for Project Management, 2012). Given the characteristics of a hybrid project team the Project design manager will have to manage both virtual- and co-located team members. Meaning that there is a need of knowledge about aspects that needs to be considered when managing a hybrid project team. When managing teams with virtual team members Merriman et al. (2007) suggest that managers should encourage discussions and team members to ask questions. It is also suggested that technology tools are not being used for information exchange only, but also for creating a sense of cohesion within the team.

As construction project performance requires team efforts there is an importance of leadership within the project. Also there are previous studies outlining the need of different leadership roles depending on the different stages of team development (Senaratne & Samaraweera, 2015). In dispersed project teams there are aspects identified such as communication, project management style and goal setting, but also managers competence and trust in a team that are considered as important for project success (Verburg, et al., 2013). Further, an efficient team needs committed team members who collaborate, this puts demand on the Project design manager who needs to create an environment where the team dynamic is working (Senaratne & Samaraweera, 2015). In the APM Body of Knowledge it is claimed that Project managers needs to understand and apply interpersonal skills and those who actively develop their interpersonal skill set are more likely to manage their work successfully (Association for Project Management, 2012).

Cascio (2000, p. 83) claims that not all managers are suited to manage virtual workplaces. For those who are, there are some common characteristics identified;

- An open, positive attitude that focuses on solutions to issues rather than on reasons to discontinue virtual-work arrangements.
- A results-oriented management style. Those who need structure and control are unlikely to be effective managers in virtual-work environments.
- Effective communications skills, both formal and informal, with employees working remotely and at the primary business location.
- An ability to delegate effectively, and to follow up to ensure that work is accomplished.

2.2.3 Distance leadership

As hybrid project teams consist of team members located at different locations this adds challenges to the Project manager that needs to lead from a distance, also called e-leadership. As a Project manager of a hybrid team it is important to understand that e-leadership is different compared to leadership performed in traditional face-to-face teams (Snellman, 2014). One of the main challenges when projects are performed virtually is to communicate with the project team (Lee, 2014). In previous studies it has been shown that working with virtual project teams, leadership becomes crucial. By creating discussion among team members, acknowledging difficulties caused by virtual communication and create defined expectations and goals, the leader can establish successful virtual teams (Purvanova & Bono, 2009).

In a study performed by Malhotra et al. (2007), two of the successful e-leadership practices identified was the ability to create trust through the usage of Information and communication technology (ICT) but also to monitor and manage the progress of the virtual team members by using technology. Malhotra et al. (2007) suggest that the project progress is being visualised virtually for all team members to be updated about the other individuals contribution to the project as this can contribute to trust within the team.

2.2.4 Communication

Effective communication has been identified as a key factor in transforming a loose group into an efficient team (Sheard & Kakabadse, 2004). This becomes crucial in a hybrid project team since communication is a key component in achieving project success with dispersed project teams (Verburg, et al., 2013). Establishing effective communication in design teams has become more important due to the growing technical and organisational complexity of construction projects. Therefore, the Project design manager needs to set the communication framework within the project team in order for the team to become efficient (Otter & Emmitt, 2007). Further, Otter and Emmit (2007, p. 410) claim that communication in a design team can be described as "interactions between a group of senders and receivers using a web of communication flows and available communication means". Communication includes both face-to-face means and electronic tools. Further, sharing information between team members is considered as essential in order for teams to be valuable. If team members do not share their unique information based on their background and competencies, the benefits of using teams will be lost. It can therefore be argued that teams where participants share information this can contribute to better decisions (Levi, 2007). In addition, Levi (2007) discuss the risk of groups often discussing common knowledge instead of sharing their individual expertise with the group. In order to avoid this problem, it is often required that the team leader actively facilitate the team communication e.g. ask questions but also creates a secure environment for all team participants to feel free to contribute to the discussions.

As a leader of a hybrid project team it becomes crucial to use ICT (Malhotra, et al., 2007). Using ICT has also been seen as an improvement of the performance of design and construction teams (Otter & Emmitt, 2007). However, the use of ICT does not itself create successful collaboration. Instead there is a need of an integrated analysis regarding how to create team identification, trust and motivation (Hatem, et al., 2012). The interpersonal skills by the Project manager becomes important in order to address

these dimensions within the project team (Association for Project Management, 2012). Otter and Emmit (2007) claim that stimulating effective communication within the team is a challenging task as there are several technologies for team communication available. Meaning that the entire team must adjust to the tools chosen within the team. Also, organisational differences regarding communication technologies might become a challenge as the project teams needs defined communication practices and thereby these might not be compatible.

Media richness in communication

As hybrid project teams include participants who are geographically dispersed there is a need of communicating virtually. This computer mediated communication (CMC) have been studied in several researches. Some argue that CMC contribute to a more task oriented collaboration as there is a lack of socioemotional and individual interaction. Other researchers claim that teams using CMC often need more time to finish a task due to the low level of social interaction among the team members (Hatem, et al., 2012). Further, Hatem et al. (2012) claim that adopting an efficient use of information communication technology needs organisational concepts such as trust, team identification and motivation.

In addition, the Project manager needs to understand that face-to-face communication does not only include the spoken words but it also gives cues by a persons' body language (Lantz, 2001). In CMC there is a lack of these cues but also a lack of trust. However, an advantage is concerned with decision-making which has been proved to benefit from CMC as it becomes more task oriented (Bosch-Sijtsema & Henriksson, 2014).

Further, Otter and Emmit (2007) claim that effective teams use both synchronous and asynchronous communication. Synchronous communication is performed at the same time such as face-to-face meetings and dialogues, but also electronic communication where participants communicate at the same time e.g. video conferencing and messenger services. On the contrary, asynchronous communication is communication carried out with a delay at different times by using technologies such as email. When working with design teams it is often considered as efficient to use synchronous communication in the early phases of the project as the agenda of the project needs to be decided upon and there is a lack of information made explicit in the 3D-models. As the process progress asynchronous communication can become more useful in terms of avoiding misunderstandings.

2.2.5 Trust

A key component in teamwork is trust which also is considered as an important aspect of an efficient team (Senaratne & Samaraweera, 2015). "Trust represents how much risk we are willing to accept in exchange for benefits from an interpersonal interaction" (Morita & Burns, 2014, p. 41). Further, trust within a team "creates a network of people that can collaboratively support a project and facilitates knowledge integration" (Morita & Burns, 2014, p. 41). This was also found in reviewed literature by Levi (2007), who claim that for individuals to experience trust, they must believe that the team is competent to complete the task, but they must also experience that the environment is safe. Further, Levi also discuss trust in terms of communication and claims that trust in teams enable communication and cooperation but it also makes conflicts easier to solve. In face-to-face collaboration, the physical and behavioural

artefacts can assess trustworthiness among the team members. However, this is not available in dispersed teams that rely on virtual communication (Morita & Burns, 2014). Also, Nydegger and Nydegger (2010) claim that establishing trust in pure virtual teams is difficult due to the lack of non-verbal cues. According to Gardiner et al. (2004) there is a general agreement that teams with high level of trust are more efficient than teams with a low level of trust. Since trust is considered as a challenge in pure virtual teams the Project manager of the hybrid project team needs to manage this. Further, Levi (2007) claims there is a close relationship between trust and communication, cooperation and teamwork.

Even though there is a challenge to establish trust within pure virtual teams, initial trust also called "swift trust" has been observed in both temporary and virtual teams (Robert, 2009). "Swift trust" is based on the reputation of team members and is most common in the initial stages of the project (Gardiner, et al., 2004). Having prior knowledge about other team members contribute to build strong trust in both face-to-face and virtual project teams (Hatem, et al., 2012). Further, Gardiner et al. (2004) claim that trust is concerned with the actions by the team members within the team and that high trust needs to be created and maintained early on in the project process. This put demands on the project leader to consider the challenge of trust already in the initial stages of the project, especially in virtual project teams (Godar & Ferris, 2004).

2.2.6 Cohesiveness and motivation

Team members are more motivated to perform in groups where they value identification with the group. Group cohesiveness increase commitment to the task and groups with a high cohesiveness often have similar goals and attitudes. Further, a group with a low level of group cohesiveness can limit a team´s ability to work together. The reason for this is considered to be that teams with a high level of cohesion often are better at communicating within the team. However, a risk with teams experiencing high level of cohesion is that group members might take decisions based on the idea that they do not want to harm the relationships within the group instead on making objective decisions (Levi, 2007).

Identification with a group has been linked to factors such as higher motivation, job satisfaction, higher group cohesion, lower in-group conflict and an increase in behaviours that correspond with the group´s identity. However, to achieve identification with a group the individuals must be motivated to identify themselves with the group (Fiol & O'Connor, 2005). Further, Rezgui (2007) claim that it is important to meet face-to-face with dispersed team members in the initial stages of a project in order to create cohesion. This also becomes essential in terms of communicating vision, mission and goal of the project.

An important component of group cohesion is problem solving and conflict resolution. Levi (2007) suggests that teams with well-functioning social functions are better at handling problems when they occur, instead of avoiding problems until they disrupt the team from performing the task. The reason for this is the idea that high level of cohesion within groups often mean that there is an open communication allowing team members to address issues more constructively. Meaning that there is a need to establish group cohesion in the initial phases of the team work.

Levi (2007, p. 64) suggests that the leader of a project can improve group cohesion in several ways such as;

- Promoting more interactions among team members
- Reducing status differences
- Ensuring that everyone is aware of one another´s contributions
- Creating a climate of pride in the team

2.2.7 Leader as a boundary spanner

Levi (2007) claim that the use of teams can improve decision-making since people with different competencies and experiences are brought together, and this can contribute to better decisions. However, this benefit is only realized if team members share their knowledge. In a study performed by Bosch-Sijtsema and Henriksson (2014), studying how to manage distributed and embedded knowledge trough interactions, it was shown that the project leader can be useful as a boundary spanner. This in terms of "integrating information, bringing towards all stakeholders, setting up and ensuring a supporting and stable work environment, bridging interaction through multiple communication means, and facilitating the knowledge community" (Bosch-Sijtsema & Henriksson, 2014, p. 1437). By operating as a boundary spanner, the project leader can bridge between project participants and stakeholders when applying an interactive environment such as Concurrent Engineering. Further, as the leader can work as a boundary spanner in terms of ensuring a supporting and stable work environment, the leader can contribute to create trust.

2.3 Concurrent Engineering

The concept of Concurrent Engineering (CE) was introduced in the 1980' in order to explain an systematic method of the product, the delivery and its support systems (Anumba, et al., 2002). CE was initially used in the aerospace and manufacturing industries but during recent years the construction industry has implemented this methodology in order to shorten the design process but also to increase quality (Chachere, et al., 2004).

The concept of Concurrent Engineering builds on shortening the time of product development and production processes, as well as improving the quality of the final product (Love, et al., 1998). The methodology of CE is to gather team members during a focused meeting where issues within the project are to be solved during a limited timeframe, e.g. meeting or day. The method uses "a singularly rapid combination of expert designers; advanced modelling, visualization and analysis tools; social processes, and a specialized design facility; to create preliminary designs for complex systems" (Chachere, et al., 2004, p. 1). The main advantages with CE are the following (Anumba, et al., 2002, p. 260);

- Getting the job right the first time around
- Increased client satisfaction
- Reduced product development time and costs, without compromising quality; and
- Eliminate waste, and costly and time-consuming downstream changes.

In Figure 3 below, a comparison of traditional, also named sequential Engineering, and CE is being illustrated. As visualized in the Figure, CE includes a shared and concurrently developed information flow as the project is being progressed compared

to sequential Engineering where the information flow is performed in one direction (Pennell & Winner, 1989).

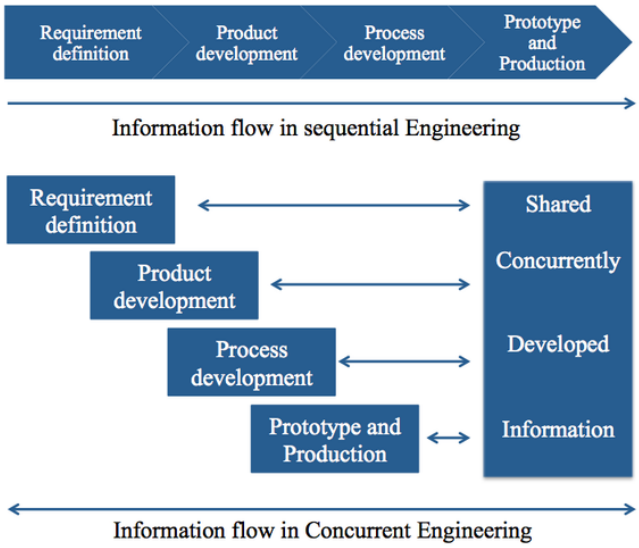

Figure 3: Information flow in sequential vs Concurrent Engineering (Pennell & Winner, 1989)

In a study performed by Bosch-Sijtsema and Henriksson (2014) it was found that when performing CE sessions the project leader needs to manage conflicts, misunderstandings and confusion between the team members. However, independent observers have reported upon a high quality design product and rapid design project completion by CE teams (Kunz & Fischer, 2012), and using multiple visual means can improve the project team and make it more autonomous (Tjell & Bosch-Sijtsema, 2015). Furthermore, the research performed by Bosch-Sijtsema and Henriksson (2014) showed that using integrated work days, such as CE, contributed to a higher level of interaction and commitment among the team members. Also the integrated work days creates a space in which team members can interact and share knowledge between each other.

When applying CE, the risk of Group decisions needs to be considered. This risk is concerned with poor critical evaluation of relevant alternatives that can reduce the quality of the product as there is an increase in speed of the progress. Another challenge with CE teams is the phenomena called Risky shift which means that teams might produce riskier choices than individuals would have select. However, collective decision-making can be prevented through team communication (Chachere, et al., 2004).

3 Methodology

The aim of this chapter is to present how the research have been carried out in terms of research strategy, research process and data collection. Further, ethical considerations involved in the research are described.

3.1 Research strategy and research design

The choice of an appropriate research strategy is important in order to increase validity and reliability of a research. Further, the research methodology needs to support the research question (Bryman, 2012). The research strategy used in the study is a qualitative research. This contribute to an understanding of the underlying issues related to the subject and will support answering the "How?" and "Why?". The main advantages with the qualitative strategy compared to the quantitative design in that a qualitative design is concerned with creating an understanding of the social world. However, Bryman (2012) argues that common critique of this research design is that it is too subjective. This criticism is concerned with the personal relationship which is frequent between the researcher and the people that are being studied. Also, a qualitative research often starts with a general focus that gets narrowed down during the research. Meaning that the researcher draw conclusions based on an unsystematic view regarding what is important. Another criticism regarding qualitative research is the difficulty to replicate due to the unstructured approach. The research is being based on what the investigator is observing and where the researcher decides to put focus. Further, problems of generalisation are common critique against the qualitative research. Often the findings are based upon a restricted amount of people in a specific social context. In a qualitative research design, it is often difficult to analyse how the study actually was executed, implicating that there is a lack of transparency. This concerns how respondents were selected and how conclusions were drawn (Bryman, 2012).

3.1.1 Research approach

The abductive approach was chosen for this study as the study focuses on the perception of the ones that are being studied, team members and Project design managers. Bryman (2012) argues that the abductive approach is similar to the inductive approach. However, the difference lies in the abductive approach relying on the explanation and understanding of the worldview of the participants. Further, the epistemological position is the one of interpretivist meaning that focus is on understanding the social world. This by doing an examination of the interpretation of the world by its participants. In addition, the ontological position of the research is the one of constructionist meaning that social properties are outcomes of the interactions between individuals (Bryman, 2012).

3.1.2 Research process

In order to increase replicability of a qualitative research, Bryman (2012) suggest a description of the research process. In the initiation of the study a research proposal was conducted in order to define the research question but also to describe the

incentive of the study. Further, relevant literature was reviewed in order to set the scope of the study. Thereafter interview guides were prepared and these were revisited after a first observation during a CE-session. After a completion of the interviews, a structured participant observation was carried out with focus on the Project design manager. When all data was obtained, interviews were transcribed and coded in Nvivo. This was lastly analysed and presented in the discussion and conclusion of the thesis. In Figure 4 below, the research process is simplified in order to create a general understanding of how the research was conducted.

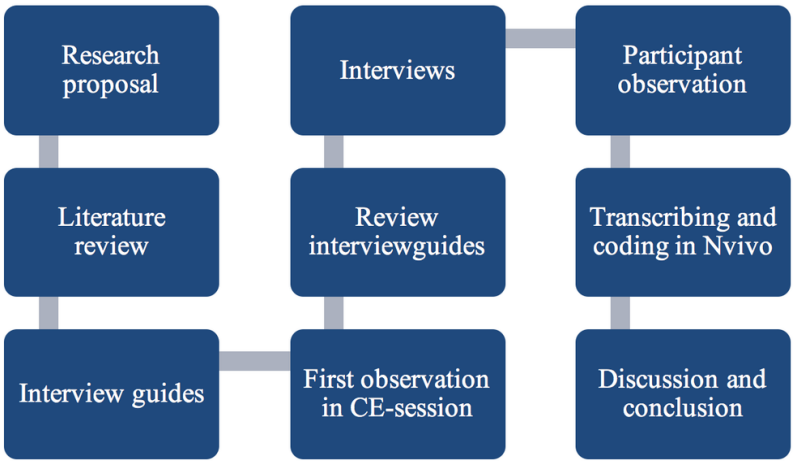

Figure 4: The research process

3.1.3 Literature review

The literature review was carried out in order to identify challenges involved with hybrid project teams. As previous literature on virtual teams often assume there is a limited amount or no face-to-face interaction (Cousins, et al., 2007), characteristics of both face-to-face and pure virtual teams were reviewed as hybrid project teams is a combination of both. Further, the literature review focused on project management literature as this can to some extend be applied on the role as a Project design manager. The literature review has been based upon the key words *hybrid project team*, *project management, Concurrent Engineering* and *group dynamics*. Literature have been sought at Chalmers library, Goggle Scholar and ScienceDirect. In Figure 5 below, the factors affecting the role of the Project design manager is illustrated.

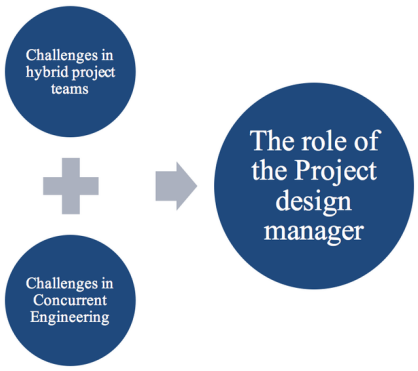

Figure 5: Challenges affecting the role of the Project design manager

3.1.4 Case study

A case study design was chosen for examining the role of the Project design manager in hybrid project teams. The term case study is often concerned with a study of a community or organisation which is being used in this study (Bryman, 2012). Criticism against case study design is often concerned with the external validity but also the ability to make generalizations based on one studied case in a specific context (Bosch-Sijtsema & Henriksson, 2014).

3.2 Data collection method

Empirical data has been obtained in two ways as described in Section 1.6. Semi-structured interviews and a participant observation have been performed. The purpose of the semi-structured interviews was to create a deeper understanding of how team members perceive the role of the Project design manager when applying Concurrent Engineering. In addition, a participant observation was carried out in order to capture additional aspects that was not addressed in the interviews.

3.2.1 Sampling in qualitative research

In the qualitative study performed a purposive sampling have been used. Purposive sampling is the opposite to non-probability sampling, meaning that respondents in the study have been selected based on their relevance for the research question. Common critique regarding this form of sampling is the lack of representativeness and generalisation among the population. This needs to be addressed by the researcher when the conclusions from the study are drawn (Bryman, 2012). The type of purposive sampling which have been used in the study is theoretical sampling. The concept of theoretical sampling builds on the idea that the researcher gathers data and during this process decisions are made concerning what data to collect next. Therefore, respondents are being selected based on the themes that needs to be address within the research, but also on the basis of being able to answer the research question. In the research, possible interviewees were identified in collaboration with the Project design manager A in the studied case. The choice of interviewees was made on their ability to answer the research question.

3.2.2 Interviewing

In order to gather empirical data, interviews were performed which is a common method of collecting data in a qualitative research (Bryman, 2012). Further, Bell (2006) claims that when using interviews the researcher can follow up on interesting points and Bryman (2012) argues that there is a sense of flexibility in the order of the questions that are being asked, but also regarding a clarification of inconsistencies in questions. The disadvantages with interviews is concerned with the time aspect as interview takes time to prepare, perform and analyse. Another challenge is regarding the analysis as it can be difficult to do this in an objective manner (Bell, 2006).

The interviews were of a semi-structured character which Bryman (2012) describes as a type of structured interview. In order for the interview questions to be the same in all of the interviews, two interview guides were prepared on forehand, one for the team members and another one for the Project design managers. The interview guides

were based on the different themes included in the research such as Concurrent Engineering, hybrid project teams and the role of the Project design manager. The interview guides are presented in (Appendix A) and (Appendix B). Forming the questions based on themes which are to be covered, is a common way of structuring interviews (Bell, 2006). Further, when structuring the interview guides there is an importance of the order in which questions are being asked. Taking this in to consideration, the interviews were introduced with questions regarding the methodology of Concurrent Engineering, as this enabled the interviewees to reflect upon the context in which the Project design manager is operating. Also, the order of the interview questions is important in terms of establishing connection with the interviewees. Thus, all of the interviews were introduced with general questions and the interviewees were also given an introduction regarding the research. The intention was not to have leading, valued, hypothetic or sensitive questions included in the interviews as this can affect the validity of the study according to Bell (2006).

3.2.3 Transcribing interviews

The interviews performed have all been transcribed. Transcribing interviews means translating the spoken answers into written words (Bryman, 2012). This in itself often work as an initial analysis as the transcription structures the interview conversation and thereby subconsciously creates a first analysis of the interview data (Kvale, 2008). As the researcher during qualitative interviews need to stay focused on following up on interesting points, audio-recording interviews can be beneficial. This enables the researcher to focus on the interviewee but it also enables an analysis of the data at a later occasion in the research (Bell, 2006). In addition, qualitative researchers are often interested in the way respondents give their answers. In that respect, audio-recording can enable the researcher to focus on the interview situation instead of writing down what is being said (Bryman, 2012). Also, taking notes during an interview can be distracting and have an impact on the free word of the interviewee (Kvale, 2008). Even though there are advantages with audio-recording interviews, it is considered as time-consuming. Moreover, interviewees might not appreciate being recorded (Bryman, 2012). Interviewees participating in the study were asked about the audio-recording and had to give their permission before this was carried out. Also, those who requested a review of the transcription before the interview data was used in the analysis were given this opportunity. However, this did not result in any changes of the transcriptions more than some clarification of terms brought up during the interviews.

3.2.4 Interview setting and context

Ten semi-structured interviews were carried out in the research. From the studied case eight project participants were interviewed; two project design managers, four co-located team members and two dispersed team members. In addition, two other respondents were included in the interviews. One of them, a Project design manager working on another infrastructure project at the same consultancy firm where a hybrid project team is applying Concurrent Engineering. This project was initiated in the end of December 2015 and had therefore been active for about three months when the interview was carried out. The other complementary interview was performed with a BIM-strategist working as a Project manager in another construction project in the

same consultancy firm initiated in the end of 2014. An overview of the interview respondents is presented in (Appendix C).

All interviews were held in Swedish as this was the native language of the research participants but also for the researcher. As described in Section 3.2.3, the research participants all gave their permission to be audio-recorded during the interviews. The interviews were held between the end of March and April 2016 and eight of them were held face-to-face as this contributes to a greater understanding as this includes body language. Two of the interviews were held on Skype for business as one of the respondents is placed in Stockholm and the other one is placed abroad. The researcher does not address this as an issue as the respondents are both used to participate on Skype meetings. In order for all of the interviewees to be prepared for the interviews, the questions were sent shortly in advance. This enabled the interviewees to understand the scope of the research, but also to suggest any other respondent if they did not considerer themselves as appropriate respondents (Bell, 2006). Also, Gillham (2005) argues that sending interview material in advance is particularly important when performing interviews on a distance as this can provide the interviewee with an understanding of the interview structure.

3.2.5 Participant observation

Similar to semi-structured interviews the participant observation provide the researcher with a more open mind in the research which enables concepts and theories to emerge out of data (Bryman, 2012). According to Bryman and Bell (2015), one of the main advantages with a structured observation is that it allows behavior to be observed directly. Further, they claim that in leadership research, researchers often rely too much on what subordinates claim that the leaders do, instead of what they actually do. In addition, an participant observation can uncover factors which are important to cover but were not identified when the study was being designed (Mack, et al., 2005). Therefore, a Concurrent Engineering session was visited before the interviews were performed, on the 15th of March 2016. This enabled the researcher to get an understanding regarding the environment in which the hybrid project team is operating. Based on the observation of a CE-session the interview questions could be reviewed before the interviews were carried out. In addition, this contributed to a basic understanding regarding how to address the participant observation performed later on. As in other data collection methods, there are disadvantages with participant observations. One disadvantage with participant observation is concerned with the subjective observation of the research as a social research aim at being objective (Mack, et al., 2005).

The participant observation was carried out on the 21th of April 2016. When performing the participant observation, the focus was on the Project design manager as this role is the main objective in the research. During the session, eleven team members participated physically in the CE-room and three team members were participating on Skype. Before the meeting begun the Project design manager gave a brief introduction of the participation observation that was going to be performed. This was motivated due to the ethical considerations where team members have the right to be informed about the study that is being carried out. During the participant observation the researcher sat in the back of the room in order not to disturb the project team as Mack et al. (2005) suggest that when performing a participant observation it is important to be prepared but also to be discreet.

3.3 Analysing

The process of how data in qualitative studies are analysed is often unclear. In qualitative studies a common difficulty is to understand how the conclusions where drawn based on the data collected (Bryman, 2012). In order to analyse the data gathered from the interviews the software Nvivo, a software for Computer-assisted qualitative data analysis, was used. This enabled the researcher to code parts of the interviews which later on enabled an analysis of the data provided among the respondents. Bryman (2012) argues that Computer-assisted qualitative data analysis software contributes to a faster and easier coding compared to doing it manually. However, it does not help with decisions regarding the analysis. Meaning that the main advantage with using Nvivo is the contribution to a more structured approach regarding the analysis of the data. Further, the data was analysed with a thematically approach where the different themes included in the interviews were being addressed. Further, Bryman and Bell (2015) claim that one of the most common criticism of coding in qualitative data analysis is regarding the issue of loosing the context in which things are being said. Therefore, the quotes included in the empirical findings are being explained in connection to the context in which quotes have been found.

3.4 Research reliability and validity

When performing social research there is an importance to reflect upon the research design criteria's such as reliability and validity. When performing a case study this is important as common criticism against this research design is concerned with the external validity and the difficulty of making generalizations (Bryman, 2012). Kvale (2008) describes reliability as the consistency and trustworthiness of research findings. Meaning that the research is able to be replicated by other researchers. This concerns both the interview situation where respondents would give the same answers to another researcher, but also the transcribing and analyze part of the research. Another analyzer shall be able to draw similar conclusions based on the data. In order to increase the reliability of the study, the data have been analyzed thematically as described in Section 3.3. It can be discussed weather or not the validity of the research is acceptable in order for the result to be generalized. The reason for this is concerned with the small amount of interviewees included in the interview study. Especially regarding the dispersed team members where only two participants were identified as dispersed. Furthermore, the level of Concurrent Engineering applied on the project can be argued not to be used in the extend it is supposed to as an active use of 3D-models during the CE-sessions were not identified during the participant observation.

3.5 Research ethics

Social research is concerned with ethical considerations that need to be addressed. Bryman and Bell (2015) discuss upon the issues of possible harm to participants, lack of informed consent, whether there is an invasion on privacy but also whether deception is involved. All of these areas have been covered in the participant consent form filled in by all of the research participants. Kvale (2008) describes the importance of informing the research participants about the purpose of the study, but also the method chosen. Further, the participants should be informed about the purpose and the procedure of the interviews and participant observation. All of the

interviewees had to give their permission for an audio-recording of the interview. During the participant observation all of the participants in the CE-session were informed about the study. Kvale (2008) claims that consequences made by the study and the possible harm to participating interviewees needs to be addressed. This motivates an anonymous presentation of the data gathered in the interviews. Also, the team included in the case study are still working together on the project. Hence, findings from the interviews need to be anonymous since it might have an impact on the relationships within the project team. In the report the interviewees are named either "Dispersed team member 1-2", "Co-located team member 1-4". Further, the Project design managers are labelled "PDM 1-3" and the Project manager is named "PM".

4 Case description

The case examined in the study focus on a hybrid project team in the design phase of an infrastructure project that will be delivered to the client during 2017. The case considers a hybrid project team at a technical consultancy firm in Sweden. The studied project was initiated in the end of 2014 at the Consultancy firm but was not active during some months in the end of 2015 due to a standstill. The project was reopened in the beginning of 2016. As the project team investigated operates in the design phase of an infrastructure project the focus lies on the Project design manager as this person has the technical responsibility of this step in the project process. The entire project includes approximately 300 consultants generating a total of 60 fulltime consultant employees. Out of these 300 consultants, nearly 25 of them are working fulltime on this particular project (Project design manager A, 2016).

The project organisation, presented in Figure 6 below, is constructed as a Matrix organisation where eight different technical units are being presented. Each technical unit has a representative participating during the Concurrent Engineering sessions. These representatives also have consultants within their units that they report back to. The Project design manager is included in the Management team and due to the size of the project, the different parts of the project also have responsible Project design managers who report directly to the general Project design manager in the Management team. The five different partial projects in the organisation structure represents a geographical area along the infrastructure line (Project design manager A, 2016).

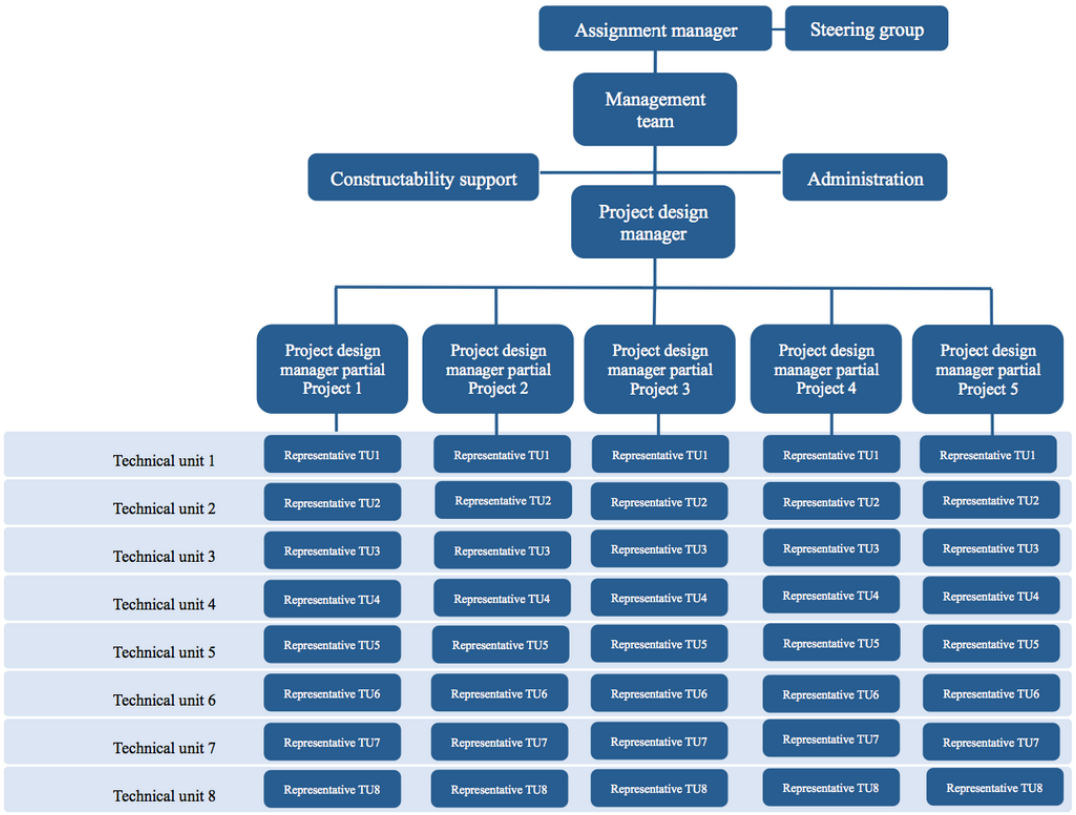

Figure 6: The Project organisation

The project team consists of both co-located and dispersed team members. Both at an organisational level where some project participants are attending CE-sessions as

virtual team members. Also, some team members are working for other firms and thereby participate as sub consultants. Meaning that they only attend when there is a need of that specific competence in order to drive the process forward. This means that the Project design manager is faced with challenges both during the CE-sessions, but also between the meetings as project participants are not working for the same organisation. In order to investigate these challenges, respondents have been chosen based upon a spread of both co-located and dispersed team members.

The studied project team uses Concurrent Engineering in combination with Virtual Design and Construction, VDC which is ”the use of integrated multi-disciplinary performance models of design-construction projects to support explicit and public business objectives” (Kunz & Fischer, 2012, p. 1). VDC creates an integrated framework and methods that consists of three main components which must and can be managed such as the product, organisation and process. Considering all of the components in VDC in parallel is valuable for a successful project development as it aim at identifying correlations in the initial stages of the project (Garcia, et al., 2004). This way of working was also found in the projects where the complementary respondents are operating.

5 Empirical Findings

In this chapter, the empirical findings from the interviews with both Project design managers as well as co-located and dispersed team members are being presented. Data from additional interviews with an external Project design manager and a Project manager is also presented in connection to the other data. Notes from the participant observations performed during a Concurrent Engineering session is also presented. First, advantages and challenges in Concurrent Engineering is presented to set the context in which the team is operating. Thereafter, challenges with hybrid project teams are presented. Lastly, findings regarding the role of the Project design manager is put forward. In this chapter, the Project design manager is named PDM as the term is frequently used.

5.1 Concurrent Engineering

As the study focus on the role of the PDM operating in the context of Concurrent Engineering, questions regarding this methodology was included in the interviews. In this section general advantages and challenges identified by the respondents are being presented as this might have had an impact on the way interviewees have answered the interview questions.

5.1.1 Advantages with Concurrent Engineering

Two of the interviewees claimed that the main advantage with Concurrent Engineering is the visualisation of the 3D-models in which the project team is working. By working jointly on a model with different expertise, correlations and conflicts can easier be addressed. If there is a need of making adjustments this can be performed during the meeting and different participants can express their opinions directly during the session. Another co-located interviewee was addressing the same advantages by arguing that the methodology enables people to be active and raise questions within the CE-session. Meaning that the amount of submission for comments decrease since you during the meeting can discuss possible solutions. The interviewee continues by saying that there can of course be situations where you get some homework, but then everyone knows what is required in order to progress in the project. This advantage with a decrease in lead times was also identified as the main benefit by the PDMs and one of the Project Managers who claimed that;

PM - *"With Concurrent Engineering we have managed to gather everyone in a project and it will facilitate the communication between the different disciplines within the project, but also with the client. The lead times in between will decrease."*

The Project manager continues by saying that the methodology can contribute to demolish the barriers between different competencies and technical units. It assists to promote a closer cooperation.

One PDM expressed the main advantages with Concurrent Engineering the following way;

PDM 2 - *"We can reach decisions sooner. We can progress faster which must be the main advantage. Everyone is gathered and it is anchored with everyone involved who*

is affected by the decision. Otherwise it can be a long way with email and it can take weeks to get a meeting with everyone involved."

The advantage of reaching decisions faster was also identified by another co-located team member. However, this requires relevant competencies attending the CE-sessions. Otherwise you need to call or email which takes time as people are often busy. Having team members attending the meetings you can progress faster as you often get lots of information when you listen to team members discussing the project. Meaning that the quality might become better, as you otherwise might need to make decisions where you do not actually have the required material.

Participant observation:

During the observed CE-session the advantage of showing material for all team participants were acknowledged. Some of the team members brought up an issue where there was a need of looking in the 3D-models for everyone to understand the problem. This supported the PDM in terms of making everyone in the CE-session understand what was being discussed. Also the PDM made the material visible for the team members participating on Skype.

5.1.2 Challenges with Concurrent Engineering

One of the main challenges identified by the respondents regarding Concurrent Engineering was the technical tools used in the session. These need to work properly in order for the sessions to run smoothly. This aspect was addressed by PDMs and both co-located and dispersed team members. One of the dispersed team members reflected upon the importance of everyone talking loud and clear. Otherwise the participants on Skype will have issues following the discussions. Also the internet connection needs to work properly otherwise the dispersed team members will receive information with delays and this will affect the progress of the CE-session.

Another challenge identified by several interviewees was regarding the presence of technical units during the CE-sessions. If not all technical units are participating, this will affect the progress of the meeting as the methodology requires competencies to attend in order to make decision which all are affected by. This was identified by one of the co-located team members who said that;

Co-located 2 - *"Everyone needs to understand the importance of attending and be present. You also need to help yourself and be prepared."*

The same respondent continued saying that when applying Concurrent Engineering one of the difficulties is to ensure that everyone is in phase. When working traditionally you can prepare your material, send it to the next person and then that person can continue working on it in their own pace. When applying Concurrent Engineering it becomes important that meetings are being prioritized, all competencies are present and everyone is prepared in order for questions to be solved.

Another challenge identified by the interviewees is that some team members might take much space during CE-sessions. However, the team members who expressed this issue claimed that this challenge also occur in projects where CE-methodology is not applied. However, it might become more substantial when utilizing Concurrent Engineering as the aim is to create an interactive environment where participants are expected to be active in the discussions.

Participant observation:

In the CE-session the difficulty of team members taking much space in the discussions were identified. This is further presented in Section 5.3.2.

5.2 Challenges in hybrid teams

The interviewees all had different previous experience from working in hybrid project teams. Although, some of the respondents claim that hybrid teams are a common way of working nowadays as the need of meeting physically has decreased due to the improved communication technologies such as ICT.

5.2.1 Communication

One PDM argued that communication is always a challenge when working in teams. However, it does not need to be more difficult in a hybrid project team. Whether communication is considered a challenge or not depends more on the individuals within the team. In other words, it depends on the communication skills among the team participants. Further, the PDM claims that it does not matter what kind of technical device used and how you make use of it. Being placed in the same geographical location simplifies communication.

PDM 3 - *"Ask anyone, I mean Skype or talking like this face to face you will never get away from the fact that we are humans. We read signals and vibrations. It is something completely different to sit together. The reason for this is that you can go and have a coffee and you have an informal conversation. But it is also an impossible thought that team members should always be co-located."*

Another PDM claimed that one difficulty with hybrid project teams is to communicate with the dispersed team members;

PDM 2 - *"Sometimes if you need to get in touch with a person to get fast decisions you can email or call but you still have no possibility to pass that person's desk. It is a bit worse accessibility for those who are far away."*

A co-located team member claimed that sharing information is a challenge when you participate from a distance. This becomes a challenge both if you are placed on either a geographical or organisational distance as it takes time for information to reach all levels. The interviewee claims that this takes more time if you participate on a distance as it is more difficult to receive information from someone as you do not run in to another team member as the informal information channels decrease. Meaning that if you are only participating on Skype during a limited time every week you receive less information compared to if you have your colleagues in the same building.

One of the co-located team members said that spontaneous communication is hard in hybrid project teams as the communication channels decrease. The team members also claim that arranged communication connected to sharing information works very well except from during the Concurrent Engineering sessions where there have been some difficulties with the technical devices.

5.2.2 Trust

None of the interviewees had experienced trust as an issue either in the specific case or in any other hybrid team. One respondent connected the high level of trust in the team to the team building activities and a sense of cohesion established in the initial stages of the project. Several interviewees believed that as the project participants are all professionals there is a high level of trust between the team members. One of the dispersed team members claimed that;

Dispersed 2 - *"I have a high level of trust to the team members. I mean they are all professionals. We all have our limitations but the most of them I think both sound and seem trustworthy in what they say. I have a great trust in them."*

Another co-located interviewee said that trust within a hybrid team is not considered as an issue as everyone assumes to a hundred percent that people do what they should, no matter if they are co-located or dispersed. This was also confirmed by another dispersed team member who said that;

Dispersed 1 - *"Trust does not depend on where you are placed, if you are co-located or working from a distance. It depends more on the individuals within the team."*

One of the respondents raised the challenge of trust to dispersed members but also said that there is trust to these team members;

Co-located 3 - *"I consider it as good but maybe you do not know if they just sit along and do something else but you don't know that. But no I guess I trust people and that they do what they should."*

5.2.3 Cohesion and motivation

During the interviews all of the team members agreed on that they can identify themselves with the team and that they experience some sense of cohesion. Even though cohesion was not addressed as an issue in the studied case, the challenge of identification as dispersed team members was discussed. A co-located team member reflected upon the dispersed members within the team and said that these individuals often do not become a part of the team in the same extent. The interviewee continues saying that if you only participate on Skype you do not get the same relations since you get somewhat excluded as you are not based at the same location.

One dispersed team member expressed the importance of being contacted by the other team members. When other project participants who are not necessarily in the same group share information you feel even more included and integrated with the project team. Even though the dispersed team members experience cohesion with the team it is important to physical meet the group in the initial stages of the project. The dispersed team members claimed that if you do not meet the project team in the initial stages of the project, the cohesion will not become very good. This was also discussed by one PDM who reflected upon identification with the team if you are dispersed and said that;

PDM 1 - *"It gets much worse. It needs to be created, it does not occur automatically. If you are co-located, you get a lot automatically but if you have dispersed team members you need to make an effort in including these individuals."*

Another co-located interviewee does not consider cohesion as an issue in a hybrid project team. On the other hand, the interviewee agrees with the dispersed team

member about the importance of once in a while meet physically with the other team members;

Dispersed 2 - *"No it does not matter but you need to meet physically once in a while. I do not think it is very good if you never meet. If you sit a hundred percent on distance it is not the same thing."*

Most of the interviewees claim that having previous experience from working together has had a positive effect on the team cohesion.

5.3 The role of the Project design manager

In the interviews questions regarding the role of the PDM when managing a hybrid project team utilizing Concurrent Engineering were addressed. The interviewees suggested aspects incorporated within the role of the PDM.

5.3.1 The changed role of the Project design manager

To get an understanding of the respondent's perception of the role as a PDM they were asked to define the role and also to reflect on the changed role when applying Concurrent Engineering. There were different perceptions among the team members in terms of if and how the role of the PDM has changed due to the implementation of Concurrent Engineering. Some of the respondents did not experience that the role has changed more than in terms of having a technical knowledge which is needed when working with 3D-models in a CE-session. This was identified by the Project manager who claimed that the role has changed due to the heavy use of 3D-modeling during the meetings.

This was also identified by another co-located team member who claimed that the PDM needs to deepen their knowledge on Concurrent Engineering methodology both in how to work and what opportunities it provides. The respondent also says that the PDM needs to have initial meetings with the BIM-strategist before every meeting in order to ensure that models are being prepared. This is not different to a traditional Design management meeting but the respondent claims that when applying Concurrent Engineering there is a technical supplement. Meaning that the PDM needs to have a close collaboration with the person responsible for the 3D-models in order to ensure that what needs to be shown is prepared.

Some of the interviewees claimed that the role as a PDM is more active when applying Concurrent Engineering and you become more of a process leader. Instead of just getting information from all parts during a Design management meeting it is a more interactive environment where you need to manage the technical aspects but also be creative and informed about how to work. Leading to that you become more of a process leader than a meeting holder.

One of the co-located team members reflected upon the changed role of the PDM and said that;

Co-located 1 - *"I believe you need to know more about how than what, if you want to be in control during the CE-sessions. If it before was enough with identifying which two participants that has a common question and ensure that they book a time and ensure they solve it. It is different in the CE-room where you are supposed to have solved questions when meetings are closed. If they are not being active themselves,*

you need to activate them and ask the right questions and ensure that they solve their question there and then. Then you need to know how. That is harder than just ensuring that they solve it but at another time."

5.3.2 Distribute the word between team members during CE-sessions

All of the interviewees claimed that the PDM has a responsibility in terms of distributing the word between the project team members in Concurrent Engineering sessions. One of the co-located team members claimed that there has been too little focus on distributing the word among the team members during CE-sessions. The respondent continues with saying that the person who holds the meeting sets the tone and this have an impact on how the meeting prolongs. One of the interviewees said that the PDM or process leader should work as a moderator during the sessions. Meaning that the PDM should steer the discussions if the team is focusing too much on details and also to bring forward individuals who might have ideas but are not saying anything.

The PDMs expect participants to be active and raise their voices if they need to bring up queries. However, some respondents expressed the difficulty of having a spontaneous distribution of the word as this encourage extrovert individuals to talk even more. One co-located team member claimed that some participants are more outgoing than others and the PDM need to bring forward those who are more introvert individuals. In addition, the PDM should actively involve those who are participating on Skype as one team member expressed that dispersed team members are easily forgotten. All of the PDMs agreed upon the importance of taking an active role in steering the discussions during CE-sessions as questions should be discussed objectively and not be affected by the more extrovert individuals. On the other hand, there are expectations on how the responsible person for each technical unit should act when their questions are on the table. Although, these expectations are not always met. The Project manager reflected upon the challenge of including everyone in the discussions;

PM - *"During the meetings some people think it is uncomfortable to talk and they do not want the same space as everybody else. In this aspect it is important as a Project design manager to steer the word and invite to a dialogue where everyone is involved so that you do not let someone sit quiet the entire day. Instead you invite to a discussion and if you see that everyone is involved it becomes more fun to participate in these CE-sessions I believe."*

One PDM said that the importance of distributing the word can vary depending on the individuals within the team and said that;

PDM 3 - *"The Project design manager has a very important role I would say. However, it can vary depending on the team members. In some groups you can sit back and in others you need to steer, to not let extrovert individuals take the lead. If you have a group with even individuals, you can sit back pretty much and steer the group more general. Often you need to focus on lifting some individuals. "Are you with us?". "What is your opinion about this?". I would say that it is extremely important."*

The PDM continuous saying that it is often easier to bring forth than to hold back some individuals.

One PDM reflected upon the difficulty when discussions head in unplanned directions when there are several participants during the CE-session and said that;

PDM 2 - *"When there are many participants in the meeting there are discussions that you did not have in mind that might take over. Then the Project design manager must, in this case me, be more active. Sometimes it is difficult, as you need to talk some things through even though you did not plan to discuss it from the beginning. The conversation is a complicated balance. Sometimes you need to steer it more as you need time to go through and make decisions in several other questions as well."*

Participant observation:

During the CE-session the PDM let the discussions prolong without distributing the word more than necessary. However, when discussions reached an end the PDM summarized the discussion and concretized the outcome. When a dispersed team member participating via Skype expressed a difficulty in following the discussion the PDM gave a brief recap of what had just been discussed. The challenge of some team members taking much space in the debates was also observed during the participant observation.

5.3.3 Create trust in hybrid project teams

Even though the interviewees did not consider trust as an issue in hybrid project teams they reflected on the role of the PDM in terms of establishing trust. One PDM claimed that in order to create trust within a project team you need to be a bit personal. Also, you need to understand the importance creating relations within the team in order to deliver successful projects. If you understand that this is important to establish, then you can be aware of it and try to work on creating trust within the project team.

One co-located team member expressed the importance of meeting the team members physically in the initial stages of the project in order to establish trust. However, all team members have a responsibility during the project to do what they should. Also, the interviewee reflects upon the size of the project and says that due to the size and complexity, the responsibilities within the project have been distributed to different participants. Therefore, the PDM should not have the responsibility of creating trust within the team in a broader extend than to ensure that all technical units participate during CE-sessions.

One PDM claimed that in order to create trust within a hybrid project team you need to show respect to all of the team members. Not give tasks too late, provide mixed messages or change things. Instead you need to be honest and clear and then you can gain trust as everyone is informed about the project progress.

5.3.4 Create cohesion in hybrid project teams

Several of the team members reflected upon the role of the PDM in terms of creating a sense of cohesion within the project team. One PDM claimed that it is important to keep spirits up and to stay calm and thereby create some kind of calmness within the team. Further, there can be activities apart from work which might contribute to

establishing cohesion within the team. Another PDM claimed that the role is of a coordinating character and said that;

PDM 1 - *"I perceive the Project design manager as a coordinator and I want to create prerequisites for everybody else to do their job and to know where the project is at the moment. To know what is expected and I also want to be a lubricant for them to have a good time."*

The PDM continues discussing the importance of being clear and structured in order for the team members to stay focused. You also need to be responsive towards the different technical units and understand what is important in different situations in order to avoid strong individuals from taking much space in the discussions. If there is not a misalignment within the team because of these things, there will be improved cohesion.

Another PDM said that it is important to create cohesion as a PDM and said that;

PDM 3 - *"As in all teams the leader has a role. If you are a unit manager or if you are a team leader for a football team it is important that you set the tone in the team. As a Project design manager you should take the responsibility you have not only for the project, but also for the people in the project. You need to show interest in them and not only their job. Just like a boss since you work more with them, but also to give feedback."*

The PDM also claim that group cohesion becomes even more important when working with Concurrent Engineering as the team becomes exposed to the client when these participate in the CE-sessions. Meaning that the team must be comfortable with each other when entering a CE-session as there is a clear agenda on what the outcome should be.

5.3.5 Prevent Risky shift and Group decisions in CE-sessions

Taking risky decisions as a team during a CE-session was not addressed as an issue in the studied case. Two interviewees claimed that this is often not an issue in the construction and infrastructure sector as processes often takes time. Instead they claim that the challenge is to actually reach decisions with the team. This was also identified by two of the PDMs and one of them said that;

PDM 1 - *"As a Project design manager you need to calm the group and say that "it is okay for us to make this decision as we need to come to an agreement in this stage of the project". It is an important role to encourage people to make decisions. Therefore, I do not see it as an issue. Instead it can be seen as a support to reach decisions as a group that the individual would not dare on its own."*

In order to reach decisions with the team one method used is to give time for consideration where team members get approximately five days to evaluate the alternatives once again. The PDM continues saying that this strategy has both withdrawn decisions but mainly ensured that the team has looked a bit extra at some alternatives. This method was also brought up by one co-located team member as a way of balancing the team from avoiding risky choices but also provide decisions to be made.

One PDM reflected upon the role as a PDM in terms of avoiding Risky shift within the project team and said that;

PDM 2 - *"In that manner you need to be awake as a Project design manager and there it is also important to have a broader knowledge so that you understand what this decision would mean but also which division that would suffer the most from the decision or where the biggest risk lies."*

Another co-located interviewee claim that one way to prevent Risky shift and Group decisions is to allocate responsibility within the project team. Being explicit about the collective responsibility and what factors that predicate a certain decision can prevent the team from making risky choices. Also, as a PDM it is important to go back and ask check-up questions to make the decision clear and ensure that factors supporting the decisions were not only expressed by accident.

Participant observation:

During the CE-session the PDM weighted pros and cons against each other when decisions were to be made. The PDM made everyone understand when there was a need of making a decision and this made team participants more involved in the discussion. When a decision had been made the PDM asked people who perhaps had something to add to do it there and then.

6 Discussion

In this chapter, the empirical data is reviewed together with the theoretical frame of reference in order to answer the research question. The discussion is divided into four parts. First the advantages and difficulties with Concurrent Engineering is discussed. Second, the challenges for the Project design manger in hybrid project teams is reviewed followed by a discussion of the changed role of the Project design manager when applying Concurrent Engineering. Lastly, the role of the Project design manager in hybrid project teams utilizing Concurrent Engineering is reviewed. In the discussion, the Project design manager is named PDM as the term is frequently used.

6.1 Advantages and challenges with Concurrent Engineering

Advantages and challenges regarding Concurrent Engineering were brought up during the interviews. Both in terms of general aspects, but also from the perspective of the PDM. The main advantage identified by the interviewees was that it creates an environment where questions are to be solve by the entire project team and this decrease the lead time between the different technical units. This is aligned with reviewed theory by Chachere et al. (2004) and Anumba et al. (2002), where the main advantages are considered as a decrease in time and an increase of quality. Another identified advantage was a closer collaboration and higher commitment among the team members as there is a feeling of a team performing a common task or project. This was discussed during the interviews where both team members and PDMs experienced an increased team spirit as the team is working closely together. For the PDM this can be considered as an advantage in terms of participants getting to know each other, and this by itself can create cohesion.

The difficulty with Concurrent Engineering is the challenge of having all technical units represented during the CE-sessions. The sessions therefore need to be prioritized as the idea with solving questions during the meeting might fail if not all competencies are present. A challenge for the PDM is therefore to ensure that everyone prioritize the meeting. Also, one difficulty discussed by all interviewees was regarding the technical tools in the CE-room that needs to work properly. Otherwise it is challenging for the dispersed team members to follow the discussions and if this does not work, the advantages of the methodology can be lost.

As Concurrent Engineering aims to establish an interactive environment there is reason to believe that this encourage team members who are powerful to take much space during CE-sessions. This challenge has been identified by Levi (2007) who argues that when decision making is performed as a group there is a risk that powerful individuals dominate the discussions. This was also brought up in the interviews where team members agreed that extrovert team members might take much space during CE-sessions. As this can be related to one of the aspects that incorporates with the role of the PDM this is further discussed in Section 6.4.

6.2 Challenges for the Project design manager in hybrid project teams

The second support question was to identify challenges for the PDM in hybrid project teams. In the reviewed literature on virtual teams it is often assumed that there is a limited amount or no face-to-face interaction (Cousins, et al., 2007; Fiol & O'Connor, 2005). However, as hybrid teams consist of both co-located and dispersed members' challenges identified within face-to-face teams and virtual teams can to some extent be applied on hybrid project teams.

Communication

All of the interviewees agreed that communication is a challenge when working in teams. Especially in hybrid constellations where some team members are co-located and others are situated in other geographical locations. Some of the respondents claimed that it is easier to discuss face-to-face. This can be connected to the theoretical frame of reference where it is explained that when communicating face-to-face you experience cues for a persons' body language (Lantz, 2001). Meaning that when communicating virtually you do not experience these cues connected with how people communicate. This can be considered as a challenge for the PDM as Cascio (2000) claim that communication skills with employees who are working both remotely and at the primary business location is a common characteristic of successful virtual leaders.

It is explained in theory that efficient teams use both synchronous and asynchronous communication (Otter & Emmitt, 2007). The empirical findings suggest that it is possible to receive fast feedback when being co-located. This is connected to synchronous communication as you can communicate simultaneously with team members that are co-located. However, the utilization of Concurrent Engineering can increase the level of synchronous communication as dispersed team members experience an improved level of synchronous communication. Meaning that there is reason to believe that Concurrent Engineering improves communication with dispersed team members.

Trust

The theoretical frame of reference present trust as a challenge in pure virtual teams as there is a lack of physical and behavioural artefacts due to the fact that communication is performed virtually (Morita & Burns, 2014). Also, those who are considered as successful leaders in virtual teams are those who are able to establish trust within the team (Malhotra, et al., 2007). As hybrid project teams consist of both co-located and virtual team members there is reason to believe that the dispersed team members experience trust as a challenge. However, in the interviews none of the interviewees agreed upon that trust was a problem in hybrid teams. Several of the interviewees claimed that all of the team members are professionals and that they all do what they should even though they are not co-located.

The reason for trust not being a challenge in the examined team might be explained by the fact that some of them had been working together in previous projects. Another explanation could be the one of swift trust which is based upon the reputation of team members (Gardiner, et al., 2004). As the majority of the team members are working for the same consultancy firm, it is not impossible that they have heard about each other from other colleagues and therefore experience trust on a professional level. This was also examined in the interview study where several of the team members

said that they had been working with other participants in previous projects. Meaning that as some of the team members have prior knowledge about each other this might have had an impact on the trust within the team. This was discussed by Hatem et al. (2012) who claimed that having prior knowledge about each other can create strong trust in both face-to-face and virtual project teams.

As several of the team members have prior knowledge about each other and therefore do not considerer trust as an issue, the challenge of trust for the PDM can not be rejected. Instead the idea that swift trust can contribute to participants' experiencing trust in the team can be confirmed.

Cohesion and motivation

In the literature review it was found that identification is a challenge in hybrid project teams. In teams where team members identify themselves with the group they are more motivated to contribute (Levi, 2007). This was also discussed in the interviews where the importance of having a face-to-face meeting in the initial stages was brought up. This was explained as the team members would have difficulties with experiencing identification with the team if there had not been a physical meeting where they got to know each other before the project starts. This can be connected to theory by Rezgui (2007), where it was argued that in teams including dispersed team members it is important to establish face-to-face interaction in the initial stages of a project in order to create some sense of cohesion.

In the examined case all of the team members experienced identification and this was motivated by the team building activities that took place in the initial stages of the project, which once again indicate the importance to gather project participants to create some kind of cohesion and identification with the team. Therefore, it can be argued that the PDM has a challenge in terms of establish cohesion among the entire team. This becomes important as it is explained in theory by Fiol and O'Connor (2005), that teams experiencing identification with the group are more likely to perform.

Create technical prerequisites

In addition to the challenges found in hybrid project teams, the interview study indicates that there is a challenge for the PDM in terms of creating technical prerequisites. If this is not made properly the challenges concerned with communication, trust and cohesion becomes even more challenging to address as team members will focus too much on the technical tools not working.

6.3 Changed role of the Project design manager

The third support question was concerned with the role of the PDM and the way this role has changed when applying Concurrent Engineering. It has been shown in previous studies that communication, group dynamic and leadership is essential in the initial stages of a project according to Senaratne and Samareweera (2015). When applying Concurrent Engineering this becomes important as the methodology aim to create an interactive environment where all team members are comfortable in expressing themselves.

In the literature review it was found that teams can be useful in terms of decision-making as people with different competencies are brought together (Levi, 2007). However, this require all team participants to share their individual knowledge with

the team. In this manner the project leader, in this case the PDM, can work as a boundary spanner as identified by Bosch-Sijtsema and Henriksson (2014). This can be argued as the methodology of Concurrent Engineering creates a possibility for team members to interact. This becomes important as the idea with the methodology of Concurrent Engineering is to gather project participants for these to share knowledge and solve questions collectively.

It was shown in the study by Bosch-Sijtsema and Henriksson (2014), that integrated work days, such as Concurrent Engineering, contribute to a higher level of interaction and commitment among the team members. Therefore, there is reason to believe that the role of the PDM when applying Concurrent Engineering is a more facilitating role as the methodology aims to create an interactive environment. This was discussed by several of the interviewees who claimed that the PDM needs to take a more active role when applying Concurrent Engineering. The reason for this some of the respondents claimed, was that issues are to be solved during the CE-sessions. Meaning that the PDM needs to know how to solve issues and what technical units that need to be included in a certain decision. This is in line with the theoretical framework where it is being identified that the methodology aims at solving issues at hand during the CE-sessions (Love, et al., 1998; Chachere, et al., 2004).

Further, the empirical findings imply that the broader competency you have as a PDM, the more active you can be in terms of involving different technical units in the discussions during CE-sessions. By knowing what is important for all of the technical units involved you have the ability to ask direct questions where there is more information needed in order to make a decision. This is aligned with theory by Eynon and CIOB (2013), where it is explained that a Project design manager needs technical knowledge but is also required to have project management, leadership and communication skills. On the contrary, it can be argued that this is needed also in projects where Concurrent Engineering is not being used. Explaining why some of the respondents did not see that the role of the PDM has changed by utilizing Concurrent Engineering.

Also, the empirical findings suggest that the PDM needs to have technical knowledge regarding the technical tools used during CE-sessions. It becomes important to understand how these are to be used but also to have a close collaboration with the BIM-strategist in the project. In other words, having a close collaboration with the person responsible for the 3D-models is essential. This becomes important as the meetings needs to be prepared with the models that are to be used and the PDM needs to understand how these can be used in the most efficient way.

6.4 The role of the Project design manager in hybrid project teams applying Concurrent Engineering

The aim of the research was to study the role of the PDM in hybrid project teams applying Concurrent Engineering. With support from the three research questions discussed, the role of the PDM can be examined.

Facilitate and ask questions

In previous research performed by Bosch-Sijtsema and Henriksson (2014) it was found that Concurrent Engineering contribute to create an interactive environment which in turn can lead to commitment among the team members. This was also found

in the interviews where it was discussed that when applying Concurrent Engineering the commitment increase among the team members as they work on the project as a team. This can also be connected to the sharing of knowledge which is important when utilizing Concurrent Engineering. This was argued by Levi (2007) who declared that groups often discuss common knowledge instead of sharing their individual knowledge with the group. In the research by Bosch-Sijtsema and Henriksson (2014) it was discussed that integrated work days create a space where team members can actually share knowledge with each other. Sharing knowledge with the other team members is crucial when applying Concurrent Engineering as the methodology depends of an interactive environment where project participants solve issues together during a limited timeframe e.g. meeting or day. This was also addressed by Dossick et al. (2010) who argues that when working collectively on a project there is a need for the leader to take an active role and thereby contribute to knowledge sharing between project participants. Levi (2007) suggests that the team leader, in this case the PDM, should actively facilitate the team by asking questions. This was also found in the empirical data where team members claimed that the PDM has a special role in terms of asking questions to participants that have not expressed their opinion in the discussions.

Communicating with the hybrid project team

As identified both in previous research by Verburg et al. (2013) and in the empirical findings, communication is challenging in hybrid project teams. Therefore, there is a reason to believe that the use of Concurrent Engineering can address this challenge to some extent as this increase the interaction with the project team members. As identified by Otter and Emmit (2007), efficient teams use both synchronous and asynchronous communication, which is the case in teams applying Concurrent Engineering. Gathering team members continuously increase the level of face-to-face communication. Especially it increases the synchronous communication with dispersed team members who otherwise are being contacted asynchronously e.g. by email in the most extent. Further, the Project design manager needs to understand that the use of ICT does not itself create successful collaboration according to Rezgui (2007). Instead there is a need for creating trust, identification and motivation as these aspects will affect the collaboration within the team. This needs to be addressed as these aspects have been shown to be challenging in hybrid project teams.

Open and comfortable environment

Levi (2007) argues that the PDM needs to create an environment where all team members are comfortable in expressing themselves and contribute to the discussions. This was also address in the interviews where it was claimed that the PDM has a major role in this aspect. If you do not create some kind of cohesion where all team participants feel secure, then the interactive environment during CE-sessions will not work properly. It can also be argued that the importance of a comfortable environment is crucial in terms of creating cohesion. As identified by Fiol and O'Connor (2005) individuals experience identification only if they are motivated to identify themselves with the team. This put demand on the PDM that needs to establish a comfortable environment where team members are motivated to identify themselves with the team. On the other hand, previous studies by Bosch-Sijtsema and Henriksson (2014) showed that using integrated work days, such as CE-sessions, contributed to a higher level of interaction and commitment among the team members. Also the integrated work days creates a space in which team members can interact and share knowledge between each other. Meaning that even though it is crucial that the PDM focus on

creating an environment where everyone share knowledge the methodology assist in this manner.

In several of the interviews it was claimed that the PDM has a role in terms of balancing extrovert and introvert individuals during CE-sessions. Some of the team members claimed that extrovert individuals have a possibility to talk even more during a CE-session as the aim is to create an interactive environment. This is in line with previous literature by Levi (2007) who discuss that powerful individuals sometimes have a tendency of dominating discussions and disrupt the groups ability to reach decisions. Meaning that there is a need for the PDM to manage the discussions during a CE-session in order for all team members to get the opportunity to contribute, but also for the team to be objective and focus on the agenda. In Figure 7 below, the balance of the PDM in CE-sessions is illustrated.

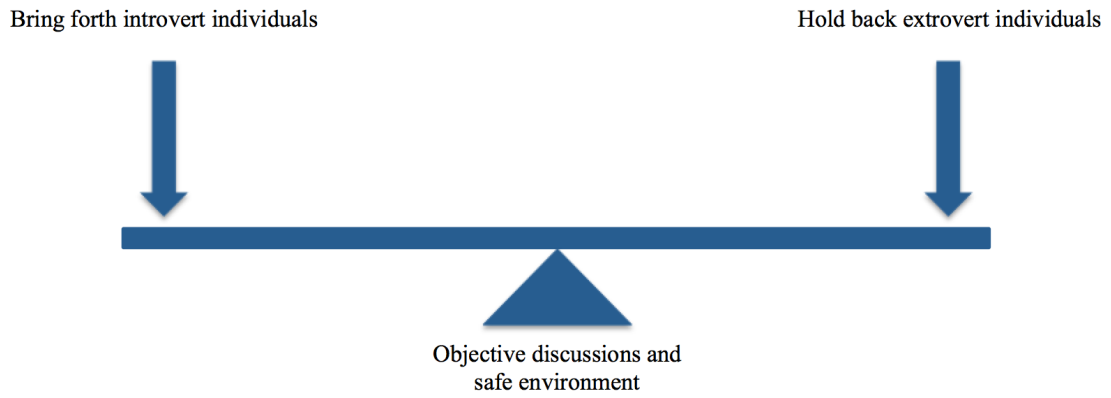

Figure 7: The balance of the Project design manager in CE-sessions

Manage discussions

In previous research by Bosch and Henriksson (2014) it was identified that when managing a CE-session the leader, in this case the PDM, needs to know how to handle conflicts. In the participant observation, no conflict was observed. However, intense discussions arose and in this manner, the PDM needs to take an active role in guiding the team to focus on the substance that once again connects to the balance of the PDM illustrated in Figure 7 above. This can also be connected to the role as a process leader which was brought up in the interviews. During the participant observation, it was observed that the PDM summarized discussions and clarified if there were some confusion in the team. This can be connected to previous findings by Bosch-Sijtsema and Henriksson (2014), where the project leader was identified as a boundary spanner in terms of bridging between project participants and stakeholders. This might become even more important during CE-sessions when the client is participating.

Prevent Risky shift and Group decisions

The challenge of Risky shift and Group decisions during CE-sessions discussed in previous research by Chachere (2004) was not supported by the interviewees. Making risky decisions is not an issue when working on infrastructure projects according to the respondents. Instead they claim that the challenge is the opposite. In other words, the challenge is to actually reach decisions. Some respondents also connected this to the characteristics of being consultants as their task is to evaluate different alternatives to the client and present these. Meaning that when there are

major decisions to be made these are not taken by the consultants or the PDM, instead these are taken by the client.

Clear agendas in CE-sessions

It was found in the literature review that Nordstrand (2008) claims that Design management is considered as teamwork with several participants who needs to have a close collaboration during the entire process. In order to deliver technical solutions, coordination between the project participants is essential and this requires administrative routines, carefully prepared communication systems but also well planned meetings. This was also brought up by some of the interviewees who claimed that the PDM needs to put some effort in preparing a clear agenda that focus on the most important questions at that stage of the project. As the team uses VDC in cooperation with Concurrent Engineering the PDM is required to collaborate with the BIM-strategist in order to ensure that 3D-models that are to be presented have been prepared. Having several competencies gathered for several hours is expensive if the time is not being used efficient and therefore the meetings need to be well-prepared. Also, the agenda should be prepared in advance as the representatives for each technical unit need time to consider what they need to prepare before the next CE-session. This becomes crucial as the hybrid project team includes dispersed team members and as argued by Cascio (2000) successful virtual leaders are those who delegate effectively. Therefore, it can be argued that the PDM should prepare clear agendas but also to delegate tasks that will not be managed during the CE-sessions but can be managed by the project participants in between CE-sessions.

7 Conclusion

The purpose of this study was to examine the role of the Project design manager in hybrid project teams applying Concurrent Engineering. As the use of hybrid project teams has become more of a common practice in the construction industry, the study contributes with an understanding concerning the management of these teams when applying Concurrent Engineering. The study addresses the Project design manager, the responsible person for the design phase of a construction project. However, the conclusions can be applied on other roles managing hybrid project teams applying Concurrent Engineering.

Advantages and challenges with Concurrent Engineering

The main advantage identified with Concurrent Engineering is interaction between project participants that it provides. This can increase quality as different competencies are collaborating and it can also decrease the lead time between the technical units as questions can be addressed collectively during CE-sessions. Hence, this require all technical units to be present when there are decisions to be made in the project. Therefore, the advantage of an interactive environment depends on the representation of the technical units. Further, technical tools in the CE-room needs to work properly for dispersed team members to follow in the discussions.

Challenges for the Project design manager in hybrid project teams

An analysis of both the theoretical frame of reference and the empirical findings indicates that the challenges of communication and creating cohesion within the project team needs to be managed by the Project design manager. The challenge of trust in hybrid project teams was identified in reviewed literature. This was not found in the case study performed which could be explained by swift trust. Even though the focus of the study was on challenges connected to hybrid project teams, the challenge of creating technical prerequisites was also identified in the empirical data gathered from both the interviews and the participant observation.

The changed role of the Project design manager when applying Concurrent Engineering

As identified in the study, the role of the Project design manager is different to some extent when applying Concurrent Engineering. One of the aspects identified was that the Project design manager is required to have a greater understanding of the technical aspects in the 3D-models used during CE-sessions. If this knowledge is not possessed by the Project design manager, a close collaboration with the BIM-strategists in the project is needed as 3D-models are to be prepared and elaborated with during CE-sessions according to the methodology. Also, there is a need for the Project design manager to take a more active role during the meetings as there are defined outcomes which needs to be delivered when the session is closed.

The role of the Project design manager in hybrid project teams applying Concurrent Engineering

The research findings indicate that the role of the Project design manager in hybrid project teams applying Concurrent Engineering is a facilitating role. Managing teams where some individuals are dispersed and others are co-located requires a facilitating role which contributes to create cohesion and establish efficient communication. As the methodology of Concurrent Engineering aims to establish a collaborative

environment, the findings suggest that there is a need to create an environment where all participants are comfortable in expressing their opinions and share knowledge with the team. Therefore, the Project design manager becomes more of a process leader that needs to actively facilitate the hybrid project team during the CE-sessions.

Research limitations and suggestions for further research

The study is considered to contribute with an understanding of challenges when managing hybrid project team applying Concurrent Engineering. However, the study has limitations concerned with validity. This is mainly motivated with the low amount of dispersed team members in the hybrid project team investigated. In order to make generalisations it would have been beneficial with a case with a higher amount of dispersed team members. This would increase the possibility to gain generalizable knowledge regarding challenges faced when managing hybrid project teams.

It should also be noted that the infrastructure project did not include a major amount of interactive 3D-models as there probably would have been in a construction project where more modelling tools are available. This was observed during the participant observation where the CE-session did not include an active use of the 3D-models explained in the methodology of Concurrent Engineering. Therefore, there is reason to believe that the result regarding the role of the Project design manager would differ if there would have been a more active use of 3D-models during the CE-sessions. In addition, several of the respondents were not familiar with the term Concurrent Engineering which made it difficult for interviewees to relate to the context in which the role of the Project design manager is being studied. This motivates further studies on the subject when the methodology of Concurrent Engineering has been more utilized.

Suggestions for further research would be to investigate time savings when performing a project with Concurrent Engineering compared to sequential Engineering. This would contribute with a solid incitement for both the consultancy firm and the client to invest in developing the use of the methodology in other projects as well. Another interesting approach would be to examine if there are any differences regarding how to manage a team in a Concurrent Engineering session depending on where in the team developing curve the team is at. This would provide the Project design manager with important knowledge regarding aspects that needs to be considered as the project team develops.

8 Recommendations and practical implications

The purpose with Concurrent Engineering is to solve questions during a limited time frame by gathering project participants and work jointly on the project. However, as identified in the study performed, extrovert individuals can take much space during CE-sessions which means that the Project design manager or the person leading the meeting needs to steer. In other words, hold back extrovert individuals and bring forth those who are not expressive in the same extent. This needs to be managed by the Project design manager in order for the team to focus on the most important questions and to be objective. In order to manage this, practical implications are suggested.

The Project design manager needs to work as a facilitator during CE-sessions

As identified in the interviews, several respondents claim that the Project design manager needs to balance the discussions during the CE-sessions in order for the team to be objective. Meaning that the Project design manager needs to hold back extrovert team members and bring forth those who are not expressive in the same extent. Otherwise there is a risk that the team focus too much on subjects that the extrovert team members bring fourth rather than what is most important for the project. Therefore, the Project design manager needs to take an active role in distributing the word between the team members to ensure that the team focus on the subjects presented in the agenda. Leading to the Project design manager possess a facilitating role.

Establish a comfortable environment for all team members

As the idea of Concurrent Engineering is to create an interactive environment where all competencies are gathered to solve issues, there is a need for an environment where all team members are comfortable in expressing themselves. Therefore, a gathering of all team members is of importance in order to create trust and cohesion within the team. This is not only important for the team to feel comfortable during the CE-sessions but also to get to know the dispersed team members. If team members are not comfortable with contributing to the discussions, the CE-sessions will not deliver the expected outcome.

Put effort in involving dispersed team members

When managing a team where some team members are placed in other geographical locations there needs to be effort put on involving these team members. This can be done by communicating with these team members but also by including them in the discussions when sitting in a CE-session. Asking direct questions to the ones participating on Skype provides team members participating physically in the CE-room with a reminder to include dispersed members in the discussions.

Create technical prerequisites

One crucial element that needs to be in place for the team to be successful is the technical devices within the CE-room. If these are not working properly the dispersed team members will face challenges in following the discussions. Meaning that there needs to be effort put on establish functioning devices otherwise there will be major difficulties for the ones' participating on Skype. This also means that the Project design manager needs to gain knowledge regarding the technical design tools practiced in CE-sessions. The Project design manager is also required to collaborate with the one responsible for the 3D-models such as the BIM-strategist in the project.

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Appendices

Appendix A: Interview guide hybrid project team members

General questions

- Could you please tell me about yourself and your work tasks?
- What is your role in the project?
- Do you mainly participate physically on the CE-sessions or via Skype?
- How do you experience collaboration within the project?
- How do you experience the climate within the project team?

Concurrent Engineering

- Can you please describe how Concurrent Engineering is used in the project?
- Do you experience that Concurrent Engineering has changed the way of working? If so, please give examples.
- What do you consider as the main challenges with the CE-methodology?
- What do you consider as the main advantages with the CE-methodology? What improvements do you recommend for future utilization of CE-methodology?

Hybrid teams

- What previous experience do you have from working in hybrid teams? (Hybrid teams means teams where a part of the team works closely on a daily basis whereas other participants are placed in other geographical locations.)
- Before you begun in the project did you have any previous relationship to the other team members? In what way do you think this has affected the collaboration?
- What challenges do you experience in hybrid teams?
    - How do you experience trust in hybrid teams?
    - How do you experience that you can identify yourself with the hybrid team?
    - How do you experience communication in hybrid teams?

∗ Additional questions asked only to dispersed team members

- In what ways can the Project design manager include team members participating on Skype for these team members experience cohesion with the team and the discussions?
- How do you experience trust to team members who participate physically during the CE-sessions?

- What challenges do you experience regarding communication when you participate on a distance?

Project design manager

- How would you define or describe the role of the Project design manager?
- Do you recon that the role of the Project design manager has changed by the CE-methodology? If so, please give examples.
- How do you recon that the Project design manager can contribute to create group cohesion? Give examples.
- How do you recon that the Project design manager can create trust in a hybrid project team?
- How do you experience that the word is being distributed between the team members? What is the role of the Project design manager in this respect?
- What challenges do you see when someone participate on Skype in CE-sessions? How can the Project design manager contribute to include these team members?
- How is information being shared during the meetings and how are CE-sessions being followed up so that team members who were not able to participate can access this information?
- How can the Project design manager avoid Risky shift and Group decisions? (Risky shift is concerned with group sometimes having a tendency to make riskier choices than what an individual would have done. Group decision on the other hand is concerned with the thought that other members in the group must have evaluated all other alternatives).

Additional comments

- Is there anything else you want to add or comment about regarding Concurrent Engineering, hybrid teams or the role as a Project design manager?

Appendix B: Interview guide Project design managers

General questions

- Could you please tell me about yourself and your work tasks?
- How do you experience collaboration within the project?
- How do you experience the climate within the project team?

Concurrent Engineering

- Can you please describe how Concurrent Engineering is used in the project?
- Do you experience that Concurrent Engineering has changed the way of working? If so, please give examples.
- What do you consider are the main challenges as a *Project design manager* with the CE-methodology?
- What do you consider are the main advantages as a *Project design manager* with the CE-methodology? What improvements do you recommend for future usage of CE-methodology?

Hybrid teams

- What previous experience do you have from working in hybrid teams? (Hybrid teams means teams where a part of the team works closely on a daily basis whereas other participants are placed in other geographical locations.)
- Before you begun in the project did you have any previous relationship to the other team members? In what way do you think this has affected the collaboration?
- What challenges do you experience in hybrid teams?
    - How do you experience trust in hybrid teams?
    - How do you experience that you can identify yourself with the hybrid team?
    - How do you experience communication in hybrid teams?

Project design manager

- How would you define or describe the role as a Project design manager?
- Do you recon that the role of the Project design manager has changed by the CE-methodology? If so, please give examples.
- How do you recon that the Project design manager can contribute to create group cohesion? Give examples.
- How do you recon that he Project design Manager can create trust in a hybrid team?

- What is your role as a Project design manager in terms of distributing the word between the team members? What is the role of the Project design manager in this respect?

- What challenges do you see when someone participate on Skype in CE-sessions? How can you as a Project design manager contribute to include these team members?

- How is information being shared during the meetings and how are CE-sessions being followed up so that team members who were not able to participate can access this information?

- How can the Project design manager avoid Risky shift and Group decisions? (Risky shift is concerned with group sometimes having a tendency to make riskier choices than what an individual would have done. Group decision on the other hand is concerned with the thought that other members in the group must have evaluated all other alternatives).

Additional comments

- Is there anything else you want to add or comment about regarding Concurrent Engineering, hybrid teams or the role as a Project design manager?

Appendix C: Overview interview participants

Label	Project	Role in the project	Hybrid	Interview duration	Interview type	Date of the interview
PDM 1	Case study	Project design manager	Co-located	1 hour	Face-to-face	2016-04-28
PDM 2	Case study	Project design manager partial project 2 and 4	Co-located	1 hour	Face-to-face	2016-04-06
Co-located 1	Case study	Representative technical unit	Co-located	1 hour	Face-to-face	2016-03-31
Co-located 2	Case study	Representative technical unit	Co-located	1 hour	Face-to-face	2016-04-01
Co-located 3	Case study	Representative technical unit	Co-located	1 hour	Face-to-face	2016-04-12
Co-located 4	Case study	BIM-strategist	Co-located	1 hour	Face-to-face	2016-04-18
Dispersed 1	Case study	Sub consultant	Dispersed but attend mostly physically in the CE sessions	1 hour	Face-to-face	2016-04-13
Dispersed 2	Case study	Sub consultant	Dispersed and attends mainly via Skype	1 hour	Skype for business	2016-04-08
PDM 3	Major infrastructure project	External Project Design Manager	Not applicable	1 hour	Face-to-face	2016-04-06
PM	Major infrastructure project	External Project manager and BIM-strategist	Not applicable	1 hour	Skype for business	2016-04-25