

THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Collaborative project delivery models in infrastructure construction

A study on collaboration, project networks and institutional change

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ABSTRACT

When projects grow into megaprojects, their management becomes more complex due to an increasing number of inter-organisational interfaces within the project organisation. Spurred on by both the growing size of projects but also the adversity and conflict-prone culture characteristic of construction, the infrastructure industry has turned to collaborative project delivery models based on relational governance. However, little is known of this new phenomenon and as literature thus far mainly focused on the procurement phase and governance, researchers have called for further insight into the delivery phase and how projects using collaborative delivery models work in practice. This thesis aims to *investigate the application of CPDM in infrastructure delivery projects and analyse changes introduced thereby for project actors*. The aim is examined through three research questions: (1) *How do social network dynamics explain the implementation of CPDM in the delivery phase of infrastructure projects*; (2) *How does using a CPDM impact project delivery*; and (3) *How does using a CPDM influence the interaction between the project network and its institutional environment?*

Collaborative project delivery models are said to support trust-building, quicker decision-making, information flow and project quality through the interaction of informal relationships and formal contractual frameworks, emphasizing the social dimension of the project organisation. With these aspects in mind, I follow the recent stream of applying social network analysis and network theories to better understand these inter-organisational relations. To create deeper insight into the changing industry, I also study the interaction of the project with its environment through an institutional lens. This thesis builds on a qualitative research design based on four main case studies. The empirical data consists of interviews, observations and document analysis. I have also mapped the social networks in three projects and approach them through a qualitative lens, focusing on the interaction between the project network and its institutional framing.

For *megaproject research*, this thesis adds rich data regarding project delivery and social networks created in large-scale project organisations. The research also identifies mechanics enabling the creation of collaborative organisations, but also the challenges of too well-connected networks. With respect to *institutional change and institutional logics*, this thesis adds insight and empirical examples of how logics interact and develop within project organisations. The contrasting results from the case studies show how the project network can either enable or constrain the development of new institutions and logics and how the project acts as an arena for change. As for *social network theory*, this thesis adds insight into the development of networks and the importance of the ties between actors as conduits of flows within the network, both pertaining to resources and change. Through empirical examples of three project networks, this thesis explains how the ‘snapshots’ of project networks have come to be and how they might develop. Finally, for *practitioners*, this thesis highlights the need for a collaborative mindset from the get-go and the importance of the formal framework as an enabler of informal social ties. For those working in the field of collaborative megaprojects, the findings acknowledge the importance of the project network and social dynamics within the project. It also highlights the necessary changes in roles and behaviours, especially in early project phases, as actors need to align their understanding of the project in unaccustomed ways.

Keywords: *project management; collaborative project delivery model; organisation; project organisation; institutional logic; project network; qualitative study; project role; project actor; construction industry; construction sector; social network theory; institutional theory; institutional logics; project as institution*

When you just do enough together and go through stuff, you notice that the other party also knows things and then you don't have to worry about those things you might not know that much about yourself.

- Project manager, contractor

LIST OF APPENDED PAPERS

This thesis is based on the work contained in the following papers:

Paper I:

af Hällström, A., Bosch-Sijtsema, P., Poblete, L., Rempling, R., & Karlsson, M. (2021). The role of social ties in collaborative project networks: A tale of two construction cases. *Construction management and economics*, 39(9), 723-738

This paper was written by Anna af Hällström, Petra Bosch-Sijtsema, León Poblete, Rasmus Rempling and Mats Karlsson. Af Hällström was the lead author and collected the data. The first version of this paper was peer-reviewed and published as a conference paper: af Hällström, A and Bosch-Sijtsema, P (2020) Collaboration and Relationships in Nordic Infrastructure Project Networks. In: Scott, L and Neilson, C J (Eds) *Proceedings of the 36th Annual ARCOM Conference*, 7-8 September 2020, UK, Association of Researchers in Construction Management, 245-254.

The conference paper was invited to be developed for a special issue of the journal *Construction Management and Economics*. The developed paper was received on the 9th of December, 2020, and published on the 25th of June, 2021.

Paper II:

af Hällström, A. and Bosch-Sijtsema, P.: Who influences collaboration? Gatekeepers and key actors in major public infrastructure projects. (Work in progress)

This paper was written by Anna af Hällström and Petra Bosch-Sijtsema. Af Hällström was the lead author and collected the data. The first version of this paper was peer-reviewed as a conference paper during the 36th Annual ARCOM Conference: af Hällström, A and Bosch-Sijtsema, P (2022) Who influences collaboration? Gatekeepers and key actors in major public infrastructure projects.

The paper is currently a work in progress and will be sent to a suitable journal in either construction management or project management during 2023.

Paper III:

af Hällström, A., Bosch-Sijtsema, P., Poblete, L., Rempling, R., & Karlsson, M.: The weakness of strong ties in project networks.

This paper was written by Anna af Hällström, Petra Bosch-Sijtsema, León Poblete, Rasmus Rempling and Mats Karlsson. Af Hällström was the lead author and collected the data. The first version of this paper was peer-reviewed and published as the conference paper af Hällström, A and Bosch-Sijtsema, P (2021) The Dark Side of Collaboration: The Risks of Strong Ties in Collaborative Project Networks In: Scott, L and Neilson, C J (Eds) *Proceedings of the 37th Annual ARCOM Conference*, 6-7 September 2021, UK, Association of Researchers in Construction Management, 402-411. The conference paper won the ARCOM 2021 Conference Price *Paul Townsend Commemorative Award for Research in Practice*.

The paper is submitted to *Construction Management and Economics* in 2023, awaiting decision.

Paper IV:

af Hällström, A. and Bosch-Sijtsema, P.: The influence of network ties on changing project delivery implementation. A study on two Nordic infrastructure projects.

This paper was written by Anna af Hällström and Petra Bosch-Sijtsema. Af Hällström was the lead author and collected the data. The first version of this paper was peer-reviewed and published as a conference paper: af Hällström, A and Bosch-Sijtsema, P (2020) Collaborative governance models towards sustainable infrastructure projects: the case of resources. In: *Beyond2020 World Sustainable Build Environment conference*, IOP Conf. Series: Earth and Environmental Science 588 (2020) 052047.

The paper is sent to Project Leadership and Society in 2023, awaiting decision.

Paper V:

af Hällström, A.: Clash of clans: Empirical evidence of conflicting institutional logics and their impact on megaproject collaboration.

This paper was written by Anna af Hällström. Af Hällström was the lead author and collected the data. The paper was presented at EURAM 2023, where it received the IJMPB Best Student Paper Award.

The paper is submitted to the International Journal of Managing Projects in Business in 2023, awaiting decision.

Papers excluded from this thesis:

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af Hällström, A. and Bosch-Sijtsema, P. (2021). *Creating Collaboration: The Use of Collaborative Space in Large-Scale Infrastructure Development* In: Scott, L and Neilson, C J (Eds) *Proceedings of the 37th Annual ARCOM Conference*, 6-7 September 2021, UK, Association of Researchers in Construction Management, 502-511

af Hällström, A. and Bosch-Sijtsema P. (2020). *Collaboration, relationships and project performance in Nordic infrastructure projects*. In: Scott, I. and Neilson, C.J. (Eds.). *Proceedings of the 36th Annual ARCOM Conference*, 7-8 September 2020 (online), UK. Association of Researchers in Construction Management, 245-254.

af Hällström, A. and Bosch-Sijtsema, P. (2020). *Collaborative governance models towards sustainable infrastructure projects: the case of resources*. Beyond2020 World Sustainable Build Environment conference, IOP Conf. Series: Earth and Environmental Science 588 (2020) 052047.

af Hällström, A. and Bosch-Sijtsema, P. (2019). *Early Contractor Involvement In The Construction Industry: A Literature Review*. In: Gorse, C and Neilson, C J (Eds.), *Proceedings 35th Annual ARCOM Conference*, 2-4 September 2019, Leeds Beckett University, Leeds, UK Association of Researchers in Construction Management, 314-323.

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It is a truth universally acknowledged that every PhD journey is similar – and yet so very different. In the beginning, there might be a novel phenomenon, a research gap or a general question about life you might want to look at in more detail. You get acquainted with the literature and different research paradigms, thinking about how you see life, *really*, when you get down to it, in detail. Is life an ineffable soup of social interaction where we build our reality in tandem with each other, or is it something beyond us; something measurable and almost tangible? But when you think about the meaning of life, the universe and where all your data suddenly disappeared from NVivo, you don't do it alone. And this page is dedicated to all those wonderful people who have made my journey so much easier, as well as more joyful, interesting and plain old *fun*.

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It all starts with a “What if...?”

It all ends with a “And then what?”



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We have all sorts of Spring Days and Fall Days and Winter Days and Summer Days and Christmas parties and other social events. Not everyone attends them, but of course you get to know people there and it's considerably easier to work with people if you know them.

- *Communication director, client*

1 INTRODUCTION

This chapter provides the empirical background to the research project, interest and focus, followed by aim and research questions.

1.1 Background and problem formulation

The late 20th and the beginning of the 21st century have been the Age of Projects and Temporal Organizing: projects have increased in both number (Lundin et al., 2015) and size (Flyvbjerg, 2014), as has the body of research in this field. The term ‘project’, traditionally at home in the construction industry and the military (where the term ‘civil engineer’ stems from – the ‘engineer’ originally referred to a military profession¹), is now used from kindergarteners and their ‘summer projects’ to fledgling scout leaders’ leadership projects and government-funded health care restructuring projects, research projects and infrastructure projects. The growing popularity of projects as an organisational form (Geraldi et al., 2020; Lundin et al., 2015; Söderlund et al., 2017) is visible in the increase in project management literature in general, the introduction of new research methods in the field (Pryke, 2012), and new project management models (Chen et al., 2018; Lahdenperä, 2012; Walker and Lloyd-Walker, 2015), such as relational governance, which emphasise the social aspects of project work and aim to improve project delivery (Bygballé et al., 2015; Chen et al., 2018; Poppo and Zenger, 2002; Rahman and Kumaraswamy, 2004).

Megaprojects are an emerging class of projects: large-scale and complex, uncertain investments which can take years and even decades to be completed and impact society (Altshuler and Luberoff, 2003; Biesenthal et al., 2018; Capka, 2004; Flyvbjerg, 2014; Söderlund et al., 2017), changing their context and institutional environment in the process. Megaprojects include more inter-organisational connections (Jones and Lichtenstein, 2008) and stakeholders (Hu et al., 2015; Zheng et al., 2016), have a larger scope (Flyvbjerg, 2014) and rely on increasing specialization of roles and responsibilities (Lahdenperä, 2012). Compared to traditional projects, the level of complexity in megaprojects is substantially greater due to increasing size and impact, as well as the rising number of interfaces (Flyvbjerg, 2014; Geraldi et al., 2011; Jones and Lichtenstein, 2008; Pauget and Wald, 2013; Sydow and Braun, 2018). Whether viewed as single projects or programmes of projects (Denicol et al., 2021), the growth of megaproject research is emphasized by recent calls for insight into the specific project context (Biesenthal et al., 2018), governance and delivery (Denicol et al., 2021).

The general trend of growing complexity and size is especially true for large-scale infrastructure delivery projects, where their oftentimes public nature, scale and size compounds possible challenges encountered during the process (Biesenthal et al., 2018; Matinheikki et al., 2019). They involve a multitude of stakeholders (Lehtinen and Aaltonen, 2020), both public and private; are increasingly formalised (Geraldi et al., 2011) through standards such as ISO 44001; are structurally complex (Denicol et al., 2021; Geraldi et al., 2011); and are delivered over years or even decades (Matinheikki et al., 2019) which makes their outcome is uncertain due to their changing context and the inter-organisational interaction within (Jones and Lichtenstein, 2008). Infrastructure delivery is moreover often society-impacting and initiated by public actors (Flyvbjerg, 2014). The inter-organisational project organisation and the uncertainties inherent in long-term infrastructure projects (Jones and Lichtenstein, 2008) requires collaborative practices to align the multitude of project participants and coordinate the myriad interfaces within the projects (Biesenthal et al., 2018; Flyvbjerg, 2014).

¹ Oxford English Dictionary, accessed 24.8.2023

However, projects sometimes do not reach their stated goals and the larger the project the more likely it is to fail (Flyvbjerg, 2014). The recent focus on improving projects through governance is due to the diminishing returns found in optimising project delivery. Although some authors claim project success lies in making projects more modular (Flyvbjerg, 2021), many projects are optimised in this regard and especially construction projects, such as rail or tunnel construction, are viewed as so unique as to be near impossible to standardise further. As Sears *et al.* (2015) state, “the vagaries of the construction site and the possibilities for creative and utilitarian variation of even the most standardized building product combine to make each construction project a new and different experience” (p.3). The construction industry is known to be slow to change (Hall and Scott, 2019; Kadefors, 1995), quarrelsome (Hansen-Addy and Nunoo, 2014) and fragmented due to a high degree of specialisation (Eccles, 1981; Löwstedt and Räisänen, 2014; Matinheikki et al., 2019). The ongoing dissociation of the field moreover increases the organisational complexity of such projects as it necessitates several experts and organisations to interact in order to deliver a collective project (Eccles, 1981; Lundin et al., 2015).

During the last decade, the construction industry has started using *collaborative project delivery models* (CPDM) to combat adversity and improve project outcomes in infrastructure projects (Bygballe et al., 2010; Chen et al., 2018; Lahdenperä, 2012; Walker and Lloyd-Walker, 2015). This is the case especially in northern Europe, where strong governmental actors have entered into dialogue with construction firms to develop the industry (Kadefors et al., 2023). These models can be defined as formalized relational approaches (Chen et al., 2018; Lahdenperä, 2012) or relational governance (Chen et al., 2018; Nwajei, 2021; Poppo and Zenger, 2002; Schepker et al., 2014) and build mainly on relational aspects (Schepker et al., 2014; Wang et al., 2021), such as early involvement of key actors and resource sharing (Chen et al., 2018), stakeholder engagement (Derakhshan et al., 2019), co-location (Kokkonen and Vaagaasar, 2018) and the interaction of formal and informal ties (Papadonikolaki et al., 2017). This phenomenon offers an interesting opportunity to develop our understanding of several aspects of projects, their context and dynamics (Schwarz and Stensaker, 2014). Examples of CPDMs include alliances (Hietajärvi and Aaltonen, 2018; Walker et al., 2015), early contractor involvement (ECI) (Scheepbouwer and Humphries, 2011), integrated project delivery (IPD) (Hall and Scott, 2019) and partnering (Bygballe et al., 2010; Eriksson, 2010). Infrastructure projects, unique and complex construction endeavours, are especially suited for the collaboration, flexibility and joint problem solving of the CPDM and the use thereof has consequently increased in the field (Chen et al., 2018; Lahdenperä, 2012; Rahman and Kumaraswamy, 2004). In these models, the three main actors are the client, design engineer and contractor, who take on project roles to execute tasks and actions. CPDM strive to integrate key actors in early contract phases, as well as having a collective charter or framework on how the project participants will collaborate, solve disputes and share risk and responsibilities (Chen et al., 2018; Walker and Lloyd-Walker, 2015) although the extent to which relational approaches are integrated in the model varies.

Due to the increasing standardisation and institutionalisation of CPDM, the use thereof introduces new processes, roles and practices into the highly institutionalised construction industry. Much work has focused on procurement, the delivery model and how the contract should be shaped (Eriksson, 2008; Eriksson and Westerberg, 2011; Laryea and Watermeyer, 2016; Volker et al., 2018; Walker and Lloyd-Walker, 2015), but less attention has been paid to the consequences this has for project delivery in terms of changes to process, practice and behaviours. With respect to the increased attention paid to relational governance and social interaction within the project organisation, social networks and institutional theory have become popular approaches in construction project research (Pryke, 2012; Pryke et al., 2017; Shi et al., 2022; Yeung et al., 2012; Zheng et al., 2016). Examples include formal and informal ties within supply chain partnerships (Papadonikolaki et al., 2017), formal and informal institutions in

projects (Wang et al., 2018), value creation (Laursen, 2018), project outcomes (Loosemore et al., 2020) and project governance (Adami and Verschoore, 2018). These networks are often viewed as self-organising (Pryke et al., 2018) and existing under both formal and informal frameworks and constellations of ties (Papadonikolaki et al., 2017; Wang et al., 2018). In this work, I focus on social networks and define the focal network as the network created within the project organisation, connecting project actors to each other through formal and informal ties, also known as the project network (Adami and Verschoore, 2018; Hellgren and Stjernberg, 1995).

Moreover, as an increasing number of projects are classified as megaproject, their inter-organisational interfaces, size and scope interact on several levels: organisations have a different dynamic than the project participants and moreover represent diverse institutional backgrounds. This, coupled with a shift towards relational governance (Schepker et al., 2014; Wang et al., 2021), requires novel approaches to governance (Denicol et al., 2021; Hietajärvi et al., 2017; Lahdenperä, 2012; Shi et al., 2022) as well as a multi-level view of the project organization. The levels of complexity act on both organizational and individual levels and a complete picture of the project requires both perspectives (Geraldi et al., 2011; Sydow and Braun, 2018).

Although the use of CPDM has garnered increasing attention both from industry, researchers and policymakers, there is still little insight into how collaboration is supported and led (Denicol et al., 2020), the changes brought by collaborative models built on a combination of formal and informal ties (Frederiksen et al., 2021) and the delivery stage of projects, focusing on the interaction of formal project governance with informal governance and relationships (Adami and Verschoore, 2018; Papadonikolaki et al., 2017). Consequently, recent research has called for a further insight into these new models and the changes they bring (Ahola, 2018; Brunet, 2021; Denicol et al., 2020; Qiu et al., 2019), as well as the mechanisms behind them (Pryke et al., 2017). Moreover, there have been calls for a deeper understanding of the interdependence between megaprojects and their context (Biesenthal et al., 2018), as well as a multi-level view of the interaction between inter-organisational relationships and formal frameworks (Dille and Söderlund, 2011; Jones and Lichtenstein, 2008; Papadonikolaki et al., 2017; Sydow and Braun, 2018). Researchers have also emphasised the importance of understanding the relational aspects of these formalized relationship approaches by applying network methods in construction research (Adami and Verschoore, 2018; Zheng et al., 2016). Although recent studies have successfully investigated aspects of the delivery stage, such as innovation in infrastructure megaprojects (Davies et al., 2014) or the creation of new institutions during tunnel construction (Matinheikki et al., 2019), current research on infrastructure projects has focused mainly on procurement and governance (Chen et al., 2018; Eriksson and Pesämaa, 2007; Rahman and Kumaraswamy, 2004), leaving the delivery stage underexplored.

1.2 Research interest, aim, purpose and scope

The focus of this thesis is on the phenomenon of CPDM in infrastructure delivery, its accompanying changes in ways of working and organising, managing collaboration in complex contexts and the project delivery stage. The aim of this thesis is to *investigate the application of CPDM in infrastructure delivery and analyse changes introduced thereby*. The purpose of this work is to *develop deeper understanding of how the CPDM approach is used in practice in infrastructure megaprojects*.

To fulfil this aim, I apply a project network lens, combined with institutional theory. This combination enables an understanding of the institutional environments both project and actors are embedded in as well as interactions between different project levels through the project network (Jones and Lichtenstein, 2008; Powell and Oberg, 2018). When focusing on project

networks, the social ties –the foundation for relational contracting– are brought to the forefront through insights into the interactions and relationships between individuals, while the institutional perspective enables a contextualisation of said relationships and understanding them on a deeper level through the interaction between network and institution (Powell and Oberg, 2018).

Informed by both previous research on relational contracting in construction as well as the perspectives of project networks and institutional theory, I first examine how collaboration is perceived in the infrastructure construction industry, whereafter I link formal collaborative governance with informal practices and social relations (Adami and Verschoore, 2018). Lastly, I look at the organisational changes brought by CPDM and changes it brings to project actors and their conventional ways of working (Frederiksen et al., 2021). This narrows the investigated phenomenon's scope as follows.

First, *collaborative project delivery models (CPDM)* are defined as delivery models based on a formalized relational approach. The extent of the formalization is irrelevant as long as the organisations participating in the project have an agreement to this end, for example as part of the contract or as a stand-alone agreement. This thus excludes traditional projects with a high degree of collaboration.

Second, since *changes* are not evident in the procurement phase, I focus on ongoing project delivery. Although the starting point of this work lies within the Nordic infrastructure sector, the challenges are global, and the discussion will thus not be limited to one geographical area in order to support generalisability.

Third, due to the perspectives taken in this work, *actors* in this work refer to both individual persons, such as project managers or collaboration coordinators, as well as organisational project participants, such as client organisations or service providers. Actors on an organisational level are the client, the contractor and the design engineer. Actors on an individual level include, but are not limited to, the project managers, collaboration coordinators, specialists and middle managers. The multi-level perspective is used to better understand network dynamics and institutional change and the work thus focuses on both the micro and meso levels, rather than merely the macro level.

Finally, the research contributes to literature both on relational governance and megaprojects through the lens of project networks and institutional theory by analysing changes created by CPDM in megaprojects. The empirical phenomenon studied –the introduction of CPDM into the infrastructure construction sector– is one operationalisation of relational governance. Since previous research has focused mainly on the procurement phase and the ‘contract’ of relational contracting, the literature reviewed in this thesis also includes studies on ongoing and completed projects, as well as the multi-level nature of megaprojects in general.

In summary, the thesis investigates the empirical phenomenon of the introduction of CPDM in the field (Lahdenperä, 2012), the institution-shaping role they play (Biesenthal et al., 2018) and their inter-organisational character and interdependencies (Jones and Lichtenstein, 2008). To narrow this research on the defined phenomenon, I examine infrastructure megaprojects with a public client, primarily in a Nordic context. I furthermore study the collaboration between the three main actors of client, contractor and design engineer to create an understanding of the project network created by a CPDM.

1.3 Research questions

On the one hand, each project organisation creates a project network through the relationships between project participants which either enables or hinders flows of information and communication (Battilana and Casciaro, 2012; Borgatti and Lopez-Kidwell, 2015) which in turn affects the way the mode of relational contracting employed plays out in the project (Papadonikolaki et al., 2017; Yeung et al., 2012; Zheng et al., 2021). On the other hand, the institutional environment of the project and participating actors impacts the project organisation (Biesenthal et al., 2018; Matinheikki et al., 2019) and thus the network created within. The project network and institution are in constant interaction and projects can also change institutions, especially if they are society-shaping megaprojects (Biesenthal et al., 2018). Thus, three research questions have guided this research.

RQ1. How do social network dynamics explain the implementation of CPDM in the delivery phase of infrastructure projects?

RQ2. How does using a CPDM impact project delivery?

RQ3. How does using a CPDM influence the interaction between the project network and its institutional environment?

RQ1 encompasses the project organisation and actors involved therein, focusing on the relational aspect of CPDM (Chen et al., 2018; Lahdenperä, 2012) and project network (Adami and Verschoore, 2018).

RQ2 looks at changes introduced into the project organisation when applying a CPDM, as well as actor interaction (Lahdenperä, 2012; Matinheikki et al., 2019; Winch and Maytorena-Sanchez, 2020).

RQ3 broadens the question and looks at the interaction between the project, the network created within and its institutional environment (Matinheikki et al., 2019; Winch and Maytorena-Sanchez, 2020) in infrastructure megaprojects.

I have experienced that a lot, that there are many people who go "They need to get out into reality, they need to see what we actually work with, they need-" And me, it's my job to say, "Yes, although they have a reality too. It is not only your reality that is the only and true one, but they also have a reality with very, very many standards and rules that they need to follow. They have a reality too".

- Design manager, contractor

2 PREVIOUS RESEARCH ON CPDM

This chapter provides the contextual background for the research project and research phenomenon, beginning in the construction industry and concluding with forms of governance.

2.1 Infrastructure delivery as a field

2.1.1 The construction industry

Construction researchers characterise the industry as adversarial, conflict-prone and litigious (Hansen-Addy and Nunoo, 2014). These problems exacerbate in infrastructure delivery, as the project's technical, organizational and contextual complexity increases (Bosch-Rekvelde et al., 2011; Matinheikki et al., 2019; Pryke et al., 2018). Organisational complexity arise especially from the increased need to manage inter-organisational relationships (Jones and Lichtenstein, 2008; Pryke et al., 2018) and uncertainty.

Prior to delving into project organising, it is important to understand the construction context. Although many mechanisms are similar to their traditional equivalents, such as bricklaying and plastering, the industry has been changing through the ages: in one way, the industry is returning to its roots through CPDM.

The industry was mainly craft-based until the 1950s. It was only during the introduction of large-scale prefabrication in the 1960s that industrialisation of construction started in earnest, although this decreased during the energy crisis in the 1970s never to properly recover (Kadefors, 1995). The industry followed global trends throughout the latter half of the century, and although the institutionalisation of the construction profession started already in the 19th century with the codification of technical education the founding of specialized professional bodies in Europe (Roselius, 2022), seeking to establish normative identities for the emergent profession (Hall and Scott, 2019), it is only during the last decades that specialisation has increased and the projects become ever more fragmented and outsourced, both by client and contractor (Eccles, 1981; Loosemore and Tan, 2000; Löwstedt and Räisänen, 2014). During this period, changes in legislative systems, the education field and standards of professional bodies further developed the field. Today, the project-based construction industry collects different actors under a distinct project umbrella to achieve a single project goal by aligning multiple different actors, their goals and expertise (Lundin et al., 2015).

The fragmentation of the industry since the 1950 has led to the aforementioned problems with adversity, conflict and litigation (Hansen-Addy and Nunoo, 2014). Different segments tried to solve this through new contracts or project management processes or project triangles. One of these efforts were undertaken by the oilfield industry in the North Sea, which started looking into collaborative delivery models in the 1980s in an effort to solve the challenges (Lahdenperä, 2012). This private sector initiative proved successful and has now been adapted in infrastructure delivery.

2.1.2 The infrastructure delivery process

To achieve goals untenable by themselves, actors enter into temporary relationships with those possessing relevant resources and initiate projects (Lundin et al., 2015). The traditional view of projects as unique endeavours has developed into viewing projects as standardisable products in tandem with the projectification of society (Lundin et al., 2015; Söderlund and Sydow, 2019), simultaneously as the perception of them has morphed from marked-based to integrated networks of actors (Ahola, 2018). In the project-based construction industry (Lundin et al., 2015), activities often take the form of inter-organisational relationships (DeFillippi and Sydow, 2016; Jones and Lichtenstein, 2008; Lundin et al., 2015). Such inter-organisational projects, where

several separate organisations interact to achieve a common time-bound goal, are common especially in the public sector with the development and delivery of infrastructure projects (Jones and Lichtenstein, 2008).

Like other projects, an infrastructure construction project can be divided into *process* and *participants*. The process traditionally comprises of a pre-project phase which culminates in signing the contract establishing the project and its goals and resources, followed by a design stage and then production and delivery. Finally, the client takes over operations and the project can be said to have fulfilled its goal as usage begins. (Lundin et al., 2015; Matinheikki et al., 2019). The aforementioned division of work into separate stages and the fragmentation of knowledge is a relatively recent invention, as mentioned above. Project success is traditionally determined by the ‘iron triangle’ of time, cost and quality (Winch and Cha, 2020).

A project can thus be viewed as either a process of activities or as actors engaging in activities (Lundin et al., 2015). An infrastructure project consists of the activities of project planning, tendering, designing, construction and inauguration. In conventional infrastructure construction, the client is traditionally involved in shaping the project in the pre-project and early project stages, before taking an arm’s length approach for the duration of the project. The design stage is the domain of design engineers and iterative development processes, while contractors enter the stage during production and delivery when linear delivery starts.

In a CPDM, actor roles and processes overlap and interact in new ways (Lahdenperä, 2012; Walker and Lloyd-Walker, 2015). The process can thus be said to consist of separate actions, either simultaneous or sequential, within the project organisation (Hughes and Murdoch, 2003). In a CPDM, the process is divided into phase 1, design, and phase 2, delivery, which often are included in one contract, with the intent that the same parties involved in phase 1 shall continue onto phase 2 so as to gain the expected benefits of early actor inclusion (Lahdenperä, 2012; Walker and Lloyd-Walker, 2015).

2.1.3 Infrastructure delivery project participants, their roles and behaviour

A construction project is delivered by project participants, both organisational and individual. Organisations are tied to the project through their contractual relationship, while individuals participate as directed by their home organisation. Home organisations participate through their individual employees, whose participation in turn takes the form of defined interactions defined as roles and their related behaviour (Hughes and Murdoch, 2003). Roles in infrastructure delivery can be either formal project roles, such as project manager, or the informal relationship between a project participant and an operation necessary for the project, such as advising, supervising or approving (ibid.) A participant can shoulder several roles depending on the purpose of the action necessitating the role as well as the participant’s role in their home organisation. The most common actions –and thus roles– in construction projects are related to project management, administration and dispute resolution, design work, construction work, and regulatory oversight (Hughes and Murdoch, 2003; Kadefors, 1995). Figure 1 presents the traditional project process.

Taking a multi-level view of the project, project actors can thus be either individuals or organisations, interacting within the project organisation (Sydow and Braun, 2018). *Individual actors* are people taking on a specific role in the project, while *organisational actors* are the organisations partaking in the project (Hughes and Murdoch, 2003). Organisation and coordination of these actors has become increasingly complicated due to the increase in project size (Flyvbjerg, 2014; Lundin et al., 2015) as well as the industrialisation of construction projects and specialisation of roles (Hughes and Murdoch, 2003).

Since individual participants are defined by their home organisation and the roles ascribed to them thereby, I will focus on three main organisational actors: *client*, *design engineer* and

contractor and the individual actors involved in project management, administration and dispute resolution, design work, construction and regulatory activities as specified by said organisations (Hughes and Murdoch, 2003; Kadefors, 1995).

The *client* creates a project to answer an internal need (Lundin et al., 2015). In infrastructure delivery, the client is often a public organisation and can be known as client, owner, or sponsor (Denicol et al., 2020). The client has traditionally held an administrative role in the delivery process, focusing on contract management (Hughes and Murdoch, 2003); nevertheless, they are crucial to effective project management (Morris and Geraldi, 2011). Clients are often characterised by a lack of knowledge regarding the process and fragmented expertise required therein, especially related to unique megaprojects (Denicol et al., 2020), emphasising the inter-organisational aspects of the project process. Especially public clients are moreover interested in both cost reduction and risk transfer (Winch and Maytorena-Sanchez, 2020), in addition to a successfully delivered project.

The *design engineer*, or engineering design consultant, is often engaged in the design stage of the project to develop the overarching project design. In conventional construction projects, their activities are focused to this phase, and they deliver finished designs at the end thereof. The design phase is iterative and design engineers may focus on multiple projects at once. Design engineers are characterised by a high degree of formal education and certification and although their home organisation can be viewed as project-based, the separation of design and construction into separate roles and organisations has been criticised, as it weakened the buildability of the designs due to a lack of construction knowledge (Lundin et al., 2015).

Traditionally, the *contractor* begins their work in project delivery, and are responsible for the project’s realisation. Construction work is often linear, with defined starting and ending points. Contractors are often project-based organisations and individual employees move from one project to the next every few months or years, depending on their specialisation, while their home organisation manages a portfolio of projects (Lundin et al., 2015). As the contractor generally rely on subcontracting (Eccles, 1981), supply chain management forms a key part of their activities (Denicol et al., 2020; Lundin et al., 2015). Contractors are moreover characterised as blue-collar tradesmen and they self-identify as “doers” (Löwstedt and Räisänen, 2014, p. 1101).

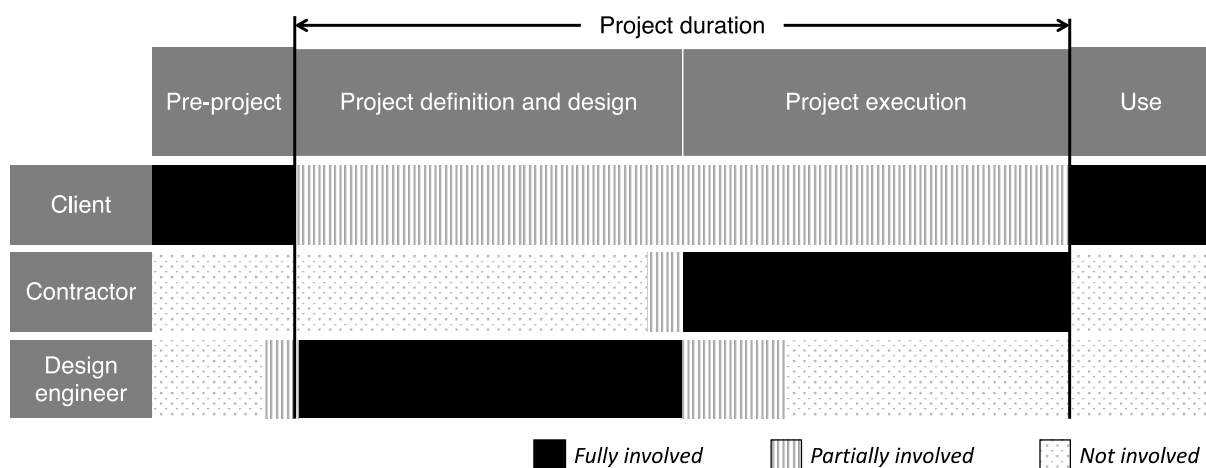


Figure 1: Traditional project process and actor involvement (af Hällström, 2021; building on Sears et al., 2015)

Literature emphasises the client and contractor when discussing actors in infrastructure projects (Hughes and Murdoch, 2003; Kadefors, 2004), excluding the role of the design engineer from

the discussion. Since design work is a key part of the process, there is a need for further study into the interdependencies within the project organisation as a whole.

2.2 Contractual and relational governance

As projects grow and more actors are brought on, the number of inter-organisational ties increase highlighting the importance of governance (Jones and Lichtenstein, 2008; Nwajei, 2021). Procurement and contractual aspects have long been a research focus (Turner, 2022), both in megaproject governance (Brunet, 2021; Denicol et al., 2021) and infrastructure and construction (Chen et al., 2018; Pryke, 2004). The field has, however, received increasing attention (Benítez-Ávila et al., 2018; Nwajei, 2021; Steen et al., 2018) and recent studies show both how social relationships increase information flow and efficiency in the project (Borgatti and Halgin, 2011) and how the structure of social relationships can shape the project (Battilana and Casciaro, 2012). The increasing number and size of projects (Flyvbjerg, 2014; Lundin et al., 2015) with the subsequent increase in inter-organisational interfaces (Jones and Lichtenstein, 2008) and project complexity (Bosch-Rekvelde et al., 2011; Matinheikki et al., 2019; Pryke et al., 2018) has moreover necessitated an increased focus on relational governance.

Both transaction-cost economics (Poppo et al., 2016; Poppo and Zenger, 1998) and principal-agent (Ahola et al., 2021; Eisenhardt, 1989; Nwajei et al., 2022; Turner, 2022) theories have been used to explain project governance (Schepker et al., 2014) and predict project success. However, authors have noted the difficulties in measuring internal performance and the lack of effective mechanisms for resolving coordination problems and opportunism (Ahola et al., 2021; Eisenhardt, 1989; Poppo and Zenger, 1998), leaving traditional contractual viewpoints lacking (Kadefors et al., 2023). Contracts also seldom encompass all possibilities and eventualities of a construction project. Moreover, relational characteristics have been described as complements to contracts, facilitating trust building and the development of relational norms (Chen et al., 2018; Poppo and Zenger, 2002; Schepker et al., 2014) and noncontractual incentives increasingly are seen as drivers of project success (Chen et al., 2018; Nwajei, 2021).

To start with, an important distinction must be made regarding the concept of ‘relational contracting’. Relational *contracting* refers to the “recognition of mutual benefits and win-win scenarios through more cooperative relationships between the parties” (Rahman and Kumaraswamy, 2004, p. 148) and is the philosophy behind relational *contracts* (Yeung et al., 2012). Thus, although a relational contract, such as alliance contracts, are based on the principles of relational contracting, it is merely the practical application of the philosophy. Yeung *et al* (2012) define relational contracting as consisting of five core elements: commitment, trust, cooperation and communication, common goals, and a win-win philosophy. There are several other aspects commonly used in relational contracting, such as a joint declaration statement or a formal contract, and project processes, such as agreed problem resolution methods and a commitment to continuous improvements (Yeung et al., 2012), but the core is a recognition of mutual benefits and the interaction of a framework of cooperative relationships and contractual obligations (Rahman and Kumaraswamy, 2004). Relational contracting has a long and widespread history, for example found in the Chinese concept of *guanxi* (Ke et al., 2019) or the Japanese equivalent of *nakama* (Rahman and Kumaraswamy, 2004), although the rise of formalized collaborative project delivery models is a quite recent phenomenon, especially in the construction industry (Lahdenperä, 2012; Rahman and Kumaraswamy, 2004).

Relational governance, however, focuses on noncontractual aspects (Chen et al., 2018; Lahdenperä, 2012; Nwajei, 2021) and although governance is a balance of contractual and noncontractual mechanisms (Bosch-Sijtsema and Postma, 2009; Chen et al., 2018; Nwajei, 2021), I will also focus on the informal governance mechanisms which frame the behavioural dimension of the project (Benítez-Ávila et al., 2018; Powell and Oberg, 2018) rather than official

contractual aspects, such as division of risk and responsibilities (Chen et al., 2018; Papadonikolaki et al., 2017).

2.2.1 The rise of megaprojects

The growing scope and scale of projects (Flyvbjerg, 2014; Lundin et al., 2015; Söderlund et al., 2017), prompts researchers to use novel designations for projects, such as major and mega (Flyvbjerg, 2014). Megaprojects are commonly described as large-scale, complex investments, that can take decades to deliver, carry considerable risks, and have a significant impact on society (Flyvbjerg, 2014). Megaprojects can moreover be viewed as collective achievements as well as a signal of change from the project client (Söderlund et al., 2017).

The most common metric for a megaproject today is *cost*: following the United States Department of Transportation's guidelines (2001), many authors argue that projects with budgets over 1 billion USD can be classified as megaprojects. However, the guidelines most often cited do merely mention the need for guidelines for projects costing more than 1 billion; not defining them as megaprojects per se. Later authors have therefore broadened the argument, calling for increased focus on complexity and ambiguity instead (Pollack et al., 2018).

Complexity in this context refers to structural factors, such as size, scope, place and pace (Geraldi et al., 2011) and the interaction therein: high uncertainty and interdependence between project actors (Adami and Verschoore, 2018; Geraldi et al., 2011); complicated stakeholder relations (Shi et al., 2022); and socio-political complexity (Geraldi et al., 2011). Complexity can furthermore be classified as either internal, related to for example tasks or organisation, or external, related to contextual uncertainties such as stakeholders or cultural issues (Hu et al., 2015).

Another metric is time: the *duration* of megaprojects is often great, exceeding local political cycles and even career spans (Biesenthal et al., 2018; Capka, 2004; Flyvbjerg, 2014). This leads to an ongoing exchange within the project organisation as actors join and leave the project, and an increased exchange with the (political) environment as political decision-makers and stakeholders need to be kept informed and aligned with the project.

Risk and uncertainty are connected to the question of complexity, yet separate. Megaprojects are often using untested processes leading to uncertain outcomes (Biesenthal et al., 2018; Flyvbjerg, 2014) and novel ways of sharing project risk changes the way project participants act. Since many infrastructure megaprojects are located in an urban setting they are also affected by local political dynamics, leading to high levels of uncertainty (Capka, 2004).

Societal impact and political dynamics play a significant part in megaproject conception and realisation (Altshuler and Luberoft, 2003; Söderlund et al., 2017). Many megaprojects are born in the public sphere and require both public and political support to proceed to delivery (Altshuler and Luberoft, 2003; Capka, 2004). Due to the impact on local markets and businesses, private actors have a vested interest in the proposed projects and consequently often advocate for them (Altshuler and Luberoft, 2003). However, due to the large local impact, megaprojects are often controversial and subject to constant monitoring from the public (Biesenthal et al., 2018; Capka, 2004).

A final topic is the *uniqueness* of projects. Although authors have furthered the idea that megaprojects can be made modular and scalable, thus enabling standardisation and greater efficiencies (Flyvbjerg, 2021, 2014), others have pointed to the particular context of construction megaprojects as major obstacles (Eriksson, 2015). A reason for the focus on 'uniqueness' may be related to the prevalence of client-centred perspectives in literature: for the client (or end user), the project often *is* a unique undertaking, even though clients of complex infrastructure projects are moving towards becoming project-supported organisations (Lundin et al., 2015).

It is thus difficult to pinpoint clearcut characteristics for megaprojects, although most authors agree on complexity, impact and duration. The main characteristics of megaprojects as discussed by literature are presented in Table 1.

Recent studies argue for a more contextual view on megaprojects, taking local circumstances into consideration when describing a project as a megaproject as well as the commonly accepted criteria, focusing instead on the “organisational complexity ambiguity, ambition, politicality and risk that are entailed” in the project (Pollack et al., 2018, p. 373). These characteristics enable megaprojects as tools of institutional change (Söderlund et al., 2017), as new practices are dispersed widely by a single, society-impacting project.

Infrastructure delivery is a field rife with megaprojects (Eriksson, 2015; Flyvbjerg, 2014; Söderlund et al., 2017), both due to the size of infrastructure construction as well as the society-impacting factor thereof, making the field a suitable research context. Infrastructure projects are often long-term, involve several different organisations, have a public client (Jones and Lichtenstein, 2008) and thus include for example tunnel and bridge construction, development of national transport systems and information and communication technology projects (Flyvbjerg, 2014). Project size has been increasing (Flyvbjerg, 2014), leading to an increasing number of inter-organisational relationships (Flyvbjerg, 2014; Jones and Lichtenstein, 2008). The construction industry is furthermore fragmented and highly specialised (Hughes and Murdoch, 2003; Kadefors, 1995), increasing the amount of inter-organisational ties further.

However, infrastructure construction has been described as being plagued by the same challenges as the construction industry in general: adversity, arms-length relationships and conflict (Hansen-Addy and Nunoo, 2014; Kadefors, 1995; Loosemore and Tan, 2000; Rahman and Kumaraswamy, 2004). As traditional project delivery models have focused on clear division of responsibility and contractual aspects (Winch and Cha, 2020), these models have shown to be unsuitable to deal with the increasing complexity of ever larger projects (Flyvbjerg, 2014; Söderlund et al., 2017). The increasing size of projects makes them more complex and interdependent (Flyvbjerg, 2014), highlighting the relational aspects of megaproject management (Galvin et al., 2021; Wang et al., 2021; Zheng et al., 2021). An additional dimension of complexity in infrastructure construction is the relationship between the client, often a public organisation that works within the local regulative framework, and the service providers, which often are private companies. Moreover, megaprojects, such as infrastructure delivery, require different management approaches due to their reach, duration, cost, uncertainties, inter-organizational nature, societal impact, and impact on value changes (Biesenthal et al., 2018). Recent research has accordingly focused on relational contracting and collaborative delivery models (Chen et al., 2018; Jelodar et al., 2016; Nwajei, 2021).

The increasing complexities and increase in inter-organisational relationships has led to the rise of relational perspectives (Chen et al., 2018; Galvin et al., 2021; Hall and Scott, 2019), with both social network, relational contracting and institutional theory showing this trend (Galvin et al., 2021; Wang et al., 2021; Zheng et al., 2021). Considering experience from ongoing projects in the area, there is a need for increased research with a particular focus on the performance phase, design and production.

Table 1: Megaproject characteristics

	<i>Argument</i>	<i>Author</i>
<i>Budget</i>	The cost has increased since the 1970 and often exceed 1 billion USD today. Critics have pointed out that not all expensive projects, however, are megaprojects.	Altshuler & Luberoﬀ (2003); Capka (2004); Flyvbjerg (2014); Pollack et al (2018)
<i>Complexity</i>	Internal and external complexity	Capka (2004); Hu et al (2015); Pollack et al (2018)
<i>Duration</i>	Megaprojects take year, and even decades, to complete and often exceed political lifecycles.	Biesenthal et al (2018); Capka (2004); Flyvbjerg (2014)
<i>Organisation</i>	Programme of projects; conglomerate of sub-projects; self-organising; inter-organisational	Denicol et al (2020); Shi et al (2022)
<i>Risk and uncertainty</i>	The interaction of multiple inter-organisational interfaces combined with other characteristics lead to high level of risk and uncertainty that must be managed.	Biesenthal et al (2018); Capka (2004); Pollack et al (2018)
<i>Size</i>	Megaprojects are large undertakings, both in terms of finances, resources and their impact on the local context, both natural and human.	Biesenthal et al (2018); Capka (2004); Flyvbjerg (2014)
<i>Societal impact</i>	Megaproject impact determines megaproject implementation; "do no harm" paradigm and mitigation of harm. Megaprojects often also span multiple jurisdictions, complicating decision-making. Advocacy groups for megaprojects are mainly led by private organisations, although they often originate in the public sphere and require public support and public entrepreneurship.	Altshuler & Luberoﬀ (2003); Biesenthal et al (2018); Capka (2004); Flyvbjerg (2014); Söderlund et al (2017)
<i>Uniqueness</i>	Megaprojects ceased to be routine in the 1970s, with their implementation dependent on local input and energy of advocates. Projects are not as unique as conventionally claims and megaprojects can be typified.	Altshuler & Luberoﬀ (2003); Flyvbjerg (2014)

2.2.2 Use of collaborative project delivery models (CPDM) in megaprojects

Due to the focus on CPDM, collaboration is a central theme of this thesis. However, the concept is used in several different ways in the field. The general consensus of ‘collaboration’ being built on trust and common goals is often mixed with the concepts of ‘cooperation’ and ‘coordination’. There are furthermore regional differences in the prevalence of how these words are used, as well as differences based in research background. This thwarts a general discussion of collaborative project delivery models, since literature does not agree on what ‘collaboration’ in this case means.

In this work, *collaboration* is defined as sharing norms and rules, the involved actors working together to achieve commonly agreed goals using shared processes and resources (Lahdenperä, 2012; Wood and Gray, 1991). Collaboration is a very involved and close-knit relationship, where actors jointly share in both project success and project failure. This requires trust and open communication (Kadefors, 2004; Yeung et al., 2012), as well as commitment to the common goal (Hietajärvi and Aaltonen, 2018).

Cooperation is usually defined as involving some joint specification and acting together for either a common goal or the actors’ individual goals (Eriksson, 2010). Actors can thus pool their

resources to either achieve a commonly agreed upon goal or reach for their own. Cooperation does not require the same depth of joint responsibility as collaboration.

Coordination, meanwhile, refers to the behaviour of aligning interests and working together (Gulati et al., 2012). Actors can thus coordinate to achieve their individual tasks, using their own resources. Coordination is the least involved method of working together.

A fourth aspect, *coopetition* is relevant to mention in this context. Coopetition, or “the balance between cooperation and competition in a specific transaction relationship, derived from the actors’ simultaneous cooperative and competitive behaviors” (Eriksson, 2008, p. 103), is a challenge to project-based industries, such as infrastructure construction, as the same organisations are both involved in the same project but also compete outside it (Eriksson, 2008). The actors must thus both share their resources while simultaneously keeping their competitive advantage when partaking in a CPDM, based on collaboration. However, since this work focuses on project delivery rather than procurement or contractual aspects, coopetition has been excluded from the research focus.

The changes ushered by the adoption of CPDMs (Hall and Scott, 2019) transform project processes and organising as new roles and practices based on increased trust and communication increase. The focus on relationships and social interconnectedness, trust and communication in CPDMs (Lahdenperä, 2012; Walker and Lloyd-Walker, 2015) highlights the individual in the project and the web of social relations within, crated in interaction between project participants (Scott, 2013). Literature furthermore calls for a multi-level approach to projects, integrating organisation and individual level perspectives (Jones and Lichtenstein, 2008; Sydow and Braun, 2018). Figure 2 presents the project process in a CPDM.

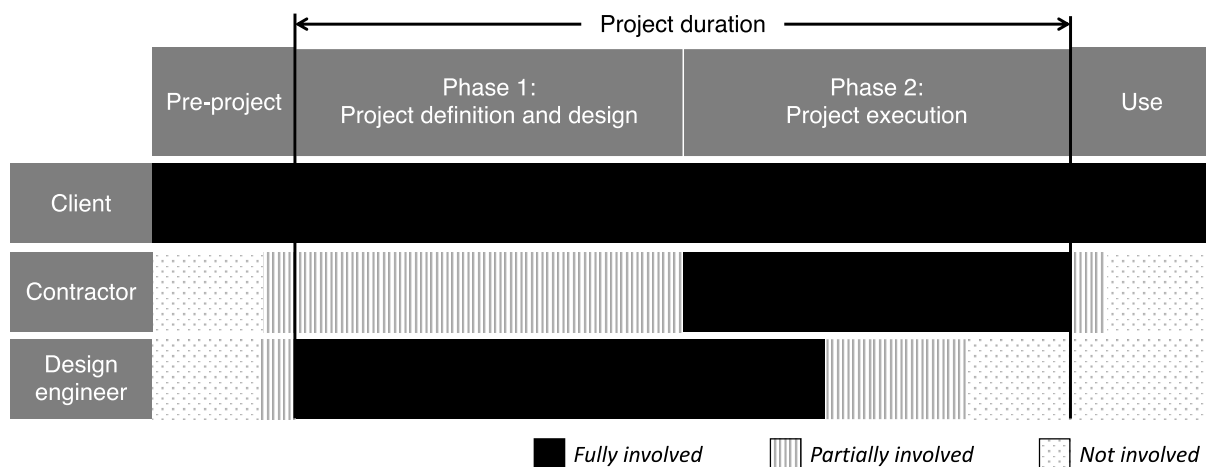


Figure 2: CPDM project process and actor involvement (from af Hällström, 2021)

The most commonly used applications of CPDM are alliancing, early contractor involvement, integrated project delivery and partnering (Chen et al., 2018; Lahdenperä, 2012; Walker and Lloyd-Walker, 2015; Yeung et al., 2012). Table 2 summarises the forms of organisation of the main CPDM approaches.

Alliances build on a collaborative multi-party contract with joint liability, joint organisation and joint decision-making, as well as contractual stipulations related to economic incentives, risk sharing and a principle of no litigation or blame (Lahdenperä, 2012; Walker and Lloyd-Walker, 2015; Yeung et al., 2012). As Walker (2015) states, “project alliances have specific clear legal agreements for no litigation unless gross negligence or criminality occurs, and this has special implications for reinforcing a no-blame culture when combined with the requirement for

unanimous decision making in clarifying relationships and settling disputes” (p.110). Yeung et al (2012) specifically points out the difference between a joint and a shared commitment in alliances as a key feature: the model builds on a joint project definition and understanding of the goals and process, as well as early inclusion of key actors (Lahdenperä, 2012; Walker and Lloyd-Walker, 2015). In the infrastructure sector, alliances have hitherto been used mainly for transport and utility projects, such as rail and road development (Lahdenperä, 2012) and have been used especially in the Australia, Finland (and to some extent the European Union), China, Hong Kong and the United Kingdom (Lahdenperä, 2012; Walker and Lloyd-Walker, 2015). Furthermore, the organisational framework of the alliance model incentivises best-for-project culture due to the strong team and trust created, enabling joint decision-making regarding the most suitable methods for delivering the project (Lahdenperä, 2012).

Early contractor involvement (ECI) is both a philosophy and a delivery model, depending on definition. The early inclusion of key actors, including the contractor, is a key feature of CPDM in general (Walker and Lloyd-Walker, 2015), although the term ‘ECI’ has been used to denote a specific type of collaborative delivery models (Scheepbouwer and Humphries, 2011; Wondimu et al., 2018). ECI has been used especially in the Anglo-Saxon sphere of influence, albeit for example Sweden has shown interest for the model in recent years (Eriksson et al., 2019). Wondimu et al (2018) identify several distinct organising implementations of ECI, although the approach often takes the form of a bilateral contract between the client and contractor, who subcontracts the design (Scheepbouwer and Humphries, 2011). Moreover, the form of the collaborative agreement depends on the approach used and may be applied differently at different project stages although it is especially important at the beginning (Wondimu et al., 2018). Thus, ECI can be viewed as being in flux and lacking a specific definition, but rather encompassing traditional contracts with early involvement of especially the contractor.

Integrated project delivery (IPD) is, like alliancing, defined by a contractual agreement, sharing risk and responsibility between the key actors in a construction project, who form a unified project organisation (Hall and Scott, 2019; Lahdenperä, 2012; Walker and Lloyd-Walker, 2015). IPD is the youngest of the CPDMs, being introduced in the beginning of the 21st century (Hall and Scott, 2019) and the model is used especially in the United States (Lahdenperä, 2012). Since variants of IPD exist, applying selected parts of the framework and disparate levels of collaboration (Hall and Scott, 2019; Walker and Lloyd-Walker, 2015), and the model lacks formal processes for selecting IPD participants (Lahdenperä, 2012), it can be said to still seek its final form.

Partnering is probably the oldest CPDM and is, like ECI, sometimes used to describe collaborative practices and delivery models in general (Lahdenperä, 2012). It is based on a shared culture and optimal resource use within the project, which in turn build on trust, common goals and mutual understanding (Lahdenperä, 2012; Yeung et al., 2012). The relationships in partnering are more distant than in alliancing or the more intimate forms of IPD and participants can thus retain more independence (Lahdenperä, 2012) which may lead to unequal projects and the model does carry the potential for abuse (Walker and Lloyd-Walker, 2015). Moreover, a partnering project often has a traditional contract at its core and a separate collaborative agreement supplementing it, although partnering contracts exist (Lahdenperä, 2012). Partnering has a global reach, but has been used especially in China, the European Union, Hong Kong, the United States, and the United Kingdom (Walker and Lloyd-Walker, 2015).

Other forms of collaborative models include for example joint ventures, public-private partnerships and supply chain management (Lahdenperä, 2012; Yeung et al., 2012), but as these are typically not included in the general definition of CPDM I have omitted them from this work.

Table 2 summarises the four principal forms of CPDM used in infrastructure construction based on contractual form, organisation and team, and typical project type. The underlying relational principles of CPDMs are often defined in a joint declaration or statement of collaboration (Walker and Lloyd-Walker, 2015; Yeung et al., 2012) and I have thus grouped them under the heading ‘collaborative agreement’.

Table 2: Summary of the principal forms of CPDM

	<i>Alliance</i>	<i>ECI</i>	<i>IPD</i>	<i>Partnering</i>
<i>Contract form</i>	Multi-party contract with joint liability; specific clear legal agreements for no litigation unless gross negligence or criminality occurs	Several different approaches; can be viewed as organising philosophy	Multi-party contract with shared risk and reward	Traditional contract
<i>Collaborative agreement</i>	The collaborative agreement is part of the contract	Depends on approach used and can be applied to either the whole project or phase one	Collaborative decision-making which can be part of the contract, depending on extent of IPD application	Non-binding partnering agreement or charter
<i>Organisation</i>	Joint organisation and joint decision-making	Depends on approach used; often separate project organisations	Depends on approach used; ranges from separate project organisations to single project organisation	Depends on approach used; often separate project organisations
<i>Types of projects</i>	Transport and utility infrastructure	Various	Health care	Various
<i>Team</i>	Single project organisation	Multiple cooperative project organisations	Single project organisation	Multiple cooperative project organisations
<i>Authors</i>	Lahdenperä (2012); Walker (2015)	Scheepbouwer and Humphries (2011); Wondimu et al (2018)	Lahdenperä (2012); Scott, Hall (2019); Walker (2015)	Lahdenperä (2012); Walker (2015); Yeung et al (2012)

3 THEORETICAL FRAMEWORK

This chapter outlines the theoretical framework used to design the research and analyse the empirical data.

3.1 Social networks in projects

A network represents relations between actors (Pryke, 2012, 2005; Scott, 2013). A network perspective helps in mapping and analysing influential actors within the project (Shi et al., 2022) and can thus help us understand social dynamics (Scott, 2013). Network perspectives have recently increased in project studies, construction research and megaproject studies alike (Pryke et al., 2017; Shi et al., 2022; Zheng et al., 2016). The effects of networks on organisations have been discussed for over half a century already (Meyer and Rowan, 1977), as have different forms of networks (Battilana and Casciaro, 2012), types of ties (Granovetter, 1973; Papadonikolaki et al., 2017) and characteristics of nodes (McPherson et al., 2001).

The history of social network theory is built on three main schools of thought: sociometric analysis and graph theory; work on interpersonal relations and ‘cliques’ in the 1930, including the Hawthorne studies; and social anthropologists in the 1950s. These converged in the 1960s and 70s at a Harvard research group, led by Harrison White (Scott, 2013). The term *social network* was coined to differentiate the relational perspective of autonomous actors, connected by ties, from research on other forms of social contexts (Borgatti and Lopez-Kidwell, 2015; Brandes et al., 2014; Scott, 2013). Social network theory thus examines the relationships within said network and social network analysis is especially well suited for empirical research (Shi et al., 2022).

Different approaches to network analysis has seen a recent increase in popularity (Borgatti and Foster, 2003; Powell and Oberg, 2018; Scott, 2013), partly due to the rise of online social media and the availability of large datasets. The analysis method is dependent on the research design and type of data collected. Scott (2013) categorises these as: variable analysis, suitable for attribute data (‘attitudes, opinions and behaviour of agents’); typological analysis, suitable for ideational data (‘meanings and motives of actions’), and network analysis, suitable for relational data (‘contacts, ties and connections’). Social network theory has recently become a popular approach also in construction research (Adami and Verschoore, 2018; Liu et al., 2015; Pryke, 2012). As the research questions of this thesis focus on collaboration and relational governance, a social network approach was deemed suitable.

3.1.1 Network nodes and project actors

A *network node* is a meeting point in the network (Borgatti and Lopez-Kidwell, 2015). In this work I will discuss these as ‘actors’ due to the conventions in the field (see e.g. Pryke, 2012). Network actors can be either individuals or organisations (Borgatti and Lopez-Kidwell, 2015; Pryke, 2005; Scott, 2013) and as it is their interaction that creates the project, this necessitates a multi-level view of the project (Sydow and Braun, 2018) rather than focusing on one or the other. In a construction setting these are both the organisations of the client, design engineer and contractor, but when taking a social network view, the term usually refers to the individuals assigned to the construction project from their home organisation. These actors may be described with attribute data, pertaining to their properties, values and norms (Scott, 2013). However, due to the focus on network properties, Scott (2013) argues for a focus on the tie characteristics instead of actor attributes, echoing Friedland and Alford’s (1991) views on the importance of understanding “the meaning of participation in these social relations” (p.252).

Organisational actors in a network are characterised by both their position in their industry/field, as well as the specifics of the organisation itself, such as age, reputation, organisation structure

and size. They are connected to each other through long-term relations due to past transactions and existent social ties between individuals (Clegg et al., 2016; Uzzi, 1996). Clegg et al (2016) note how the discussion on organisations has moved from a market-based view, including transaction cost perspectives, towards a view of organisations as networked entities combining internal and external resources through value chain collaboration, outsourcing and market alliances. Thus, organisations become part of a larger networked field, enabling field-level interaction and dispersion of norms and practices (Clegg et al., 2016; DiMaggio and Powell, 1983; Meyer and Rowan, 1977). These relationships become self-governing to a degree, especially in the temporal project organisation (Pryke et al., 2018). Organisations within the construction industry moreover often act in competition, but may cooperate in especially large projects with multiple participating organisations, creating tension between competitive and collaborative practices that result in coopetition (Bengtsson and Kock, 2000; Eriksson, 2010; Winch and Maytorena-Sanchez, 2020).

Individual actors are the individual persons participating in the project through their home organisation. These are characterised both by their formal project role, as determined by their home organisation, but also by demographic factors, such as age, gender or educational background, as well as their position in the industry as determined by reputation and expertise. Individual actors also form the basis for the social network, as these networks consist of human interaction. According to Powell and Oberg (2018) "increased interaction among participants is facilitated by societal rules that smooth the establishing and deepening of social relationships" (p.448). Individuals furthermore often share more than one social relationship, such as colleagues, friends or family, which impacts how a particular interaction is interpreted and increases the probability of similar people creating positive social relationships (McPherson et al., 2001). The interaction of individual nodes, their larger contexts and individual networks, such as employment or organisational membership, create larger social frameworks (Powell and Oberg, 2018).

3.1.2 Ties and relations

Actors are connected by *ties*: relations of their official roles, their organisational background and the social relationships created within the project (Pryke, 2012; Scott, 2013). Since the beginning of modern network discourse there have been calls for further insight into the characteristic of ties (Clegg et al., 2016; Granovetter, 1973) and although several researchers have looked at tie strength (Zeng et al., 2022), many of the approaches to social network analysis have hitherto mainly focused on nodes and the impact of the network on them –or their impact on the network– in the form of structural holes (Burt, 2001), social capital (Newton, 1997) or node centrality and its impact on network structure (Cook et al., 1983).

A *network tie* is a connection between two actors. I am here not following the traditional graph-theory definition of the relations between actors being a 'path', or "a sequence of adjacent [actors] in which no [actor] is visited more than once" (Borgatti, 2005, p. 60) but rather as 'ties': social connections between actors (Borgatti and Lopez-Kidwell, 2015; Scott, 2013). Thus, my focus is on the character of the individual social ties between individual nodes on one level, and on the more ethereal ties between organisational nodes on another. Ties therefore both connect individuals but also larger social entities, such as companies or project organisations (Powell and Oberg, 2018). Network ties can be either *formal* or *informal* (Borgatti and Halgin, 2011; Papadonikolaki et al., 2017) as well as being characterised by their temporality, being either constant or transitory (Borgatti and Halgin, 2011).

Formal ties can be observed or measured and are part of the project organisation. Constant formal ties include static elements, such as contracts, both between organisations but also between the individual actor and their home organisation, while transitory formal ties include

codified actions, for example project meetings and weekly schedules (Borgatti and Halgin, 2011; Papadonikolaki et al., 2017).

Informal ties occur spontaneously. Constant informal ties include social ties between two individual actors, while transitory informal ties include spontaneous communication (Borgatti and Halgin, 2011), for example in a co-located project office (Kokkonen and Vaagaasar, 2018). Informal practices, creating the basis for informal ties, are “an irremediable property of organizational work” (Boudeau, 2013, p. 87) and although formal procedures form the basis for informal practices to occur in a project, they are enacted through the informal methods of the project participants (ibid.).

The interaction between formal and informal governance, as mentioned previously with respect to contractual and relational governance, is mutually complementary (Poppo and Zenger, 2002; Pryke et al., 2018), although research thus far mainly has focused on the formal mechanisms. Moreover, since researchers hitherto have focused on different tie configurations and network structures (Battilana and Casciaro, 2012; Clegg et al., 2016) or the strength of ties (Zeng et al., 2022), little is known about different ties and their characteristics within project organisations, even though the corpus on ties in general is considerable.

3.1.3 Network structure and dynamics: a qualitative approach

Complex networks, such as social networks, are characterised by a short path length between any two given nodes known as *small worlds*; *clustering* of nodes; and a *degree distribution* with a power-law tail (Albert and Barabási, 2002). Albert and Barabási (2002) defines the concepts as follows: *Small worlds* refers to the relatively short path length between two actors in networks and the slow rate of increase in this path length as the network grows. *Clustering* refers to the proportion of possible ties between actors to the actual number of ties, and thus to the structure and grouping within the network. Lastly, *degree distribution* refers to the amount of central actors within the network, or to the proportion of highly connected actors to those with fewer ties.

A network can be viewed either as the framework for flows (Borgatti and Lopez-Kidwell, 2015; DiMaggio and Powell, 1983), such as social capital or resources, or through the structure –the alignment of actors– of the network (Battilana and Casciaro, 2012; Borgatti and Lopez-Kidwell, 2015). In this work, I have focused on both aspects. Network structure is based on *transitivity* (the tendency of nodes in a network to form clusters or triangles; higher transitivity indicates higher cohesion), *density* (the proportion of existing edges to possible edges in the network; a measure of connectedness), *clustering* (how modular, or bridging, the network is) and *average path length* (the average length between two nodes in the network) (Albert and Barabási, 2002; Battilana and Casciaro, 2012; Scott, 2013). These aspects inform the structure, making a network cohesive or bridging, which in turn determines the flows within the network (Battilana and Casciaro, 2012). A cohesive network enables unrestricted flows throughout while a bridging network contains flows within clusters (ibid.), emphasizing the importance of bridging ties and ‘gatekeepers’ (Burt, 2001).

Key centrality concepts based on the actor and their position in the network, such as *degree* (the number of ties an actor has), *betweenness* (the actor’s centrality as a transit point for network flows, or a broker), *eigenvector centrality* (how well connected an actor’s connections are) and *closeness* (distance to others in the network) are also relevant to look at (Albert and Barabási, 2002; Borgatti and Lopez-Kidwell, 2015; Pryke et al., 2018). Moreover, as social networks are built on relational data –the connections between nodes– this perspective is based on dialogue and understood by interpretation (Scott, 2013). Relational data, regarding the connections between nodes, is created through the interaction between two nodes (Borgatti and Lopez-Kidwell, 2015; Scott, 2013). Social network analysis is thus at its core a qualitative measure

of network relations, although quantitative analysis based on statistical properties of relational patterns is often used (Scott, 2013).

3.1.4 Project networks

Due to the focus on social relations, a network perspective can increase our understanding of the inter-organisational dynamics within novel project delivery models (Ahola, 2018; Laursen, 2018), a perspective that has increased in popularity recently in the construction literature (Loosemore et al., 2020; Pryke et al., 2018; Zheng et al., 2016). While current literature discuss dyadic relations within such projects, often between client and contractor (Kadefors, 2004), and a small but increasing number focus on the network aspect, there is a lack of insight into the relational aspects of project organisations. Since a *project network* is created by the social interaction within the project network (Adami and Verschoore, 2018; Ahola, 2018; Hellgren and Stjernberg, 1995), it can help unveil the relationships within the project organisation. It is thus based on the individual actors within the project rather than the organisational actors. However, the participating organisations are connected by the informal social relations between their employees and through the formal relations of contracts (Papadonikolaki et al., 2017).

Moreover, megaprojects “naturally appears to be a network due to its complexity, uncertainty, ambiguity, and strong degree of embeddedness in relationships” (Shi et al., 2022, p. 14). Project networks within megaproject are a mix of formal and informal relations (Papadonikolaki et al., 2017; Shi et al., 2022). The megaproject network can be described as having a core-periphery structure, with the project organisation forming the core and less involved actors, such as supply chain and specialist advisors, in the periphery (Shi et al., 2022). Megaproject networks are moreover autonomous and self-organising (Pryke et al., 2018; Shi et al., 2022), in part due to the organisational set-up and high degree of independence offered by the governance model (Denicol et al., 2021).

The project network is thus created in and by the project while the dynamics within it enables the project to react and organise around pertinent topics. The project manager in such a context must promote these abilities (Pryke et al., 2018). The introduction of CPDM emphasises social ties and relational governance, as well as the interplay between relational and contractual governance (Chen et al., 2018; Poppo and Zenger, 2002). A perspective based on project networks can thus, in addition to increasing our understanding of inter-organisational interactions, also help discern dynamics and structures within the project and improve our understanding of the nature of social ties.

However, a project network is merely a lens through which to view interconnections between actors and depend on its context to establish its content –that is, types of ties, characteristics and situational beliefs– which in turn explains the dynamics within (Friedland and Alford, 1991; Granovetter, 1985; Scott, 2013). These are all based on the project environment. A perspective taking the governing institutional dynamics into account can help us understand project networks on a deeper level (Powell and Oberg, 2018).

3.2 The Institutional context

The increase in research into the interplay of relational and contractual governance (Benítez-Ávila et al., 2018; Chen et al., 2018; Nwajei, 2021; Schepker et al., 2014; Steen et al., 2018) points to a growing understanding of the network dimension. However, a growing body of literature also focuses on the institutional dimension (Biesenthal et al., 2018; Brunet, 2021; Winch and Maytorena-Sanchez, 2020), arguing that the interaction of the project and its environment is critical in understanding projects. The connectivity to the public as well as private environment contains an opportunity for innovation and new practices when actors are exposed to institutional

forms which differ from the accustomed structure of their home organization (Holti, 2011; Powell and Oberg, 2018). “Networks shape institutions but institutions sculpt networks and direct their growth” (p.603), as Powell and Oberg (2018) assert. This is seen in the effects of participating organizations on the ties and thus the network itself. Moreover, the norms and expectations that shape institutions also influence the formation of relationships within the project organization and thus the project network structure itself (Powell and Oberg, 2018).

I follow Glynn (2023) and Scott’s (2014) definition of an institution as the “regulative, normative, and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life. They are social structures, continuously constructed, upheld and developed by the actors participating therein, that guide behaviour and expectations (Glynn and D’auanno, 2023; Scott, 2014). Institutions are the background noise of everyday life, their particular processes and obligations directing and legitimise organizations and increasing their resources (Meyer and Rowan, 1977). However, this also creates tension within and between organizations as the faithful application of institutional processes and norms creates inconsistencies (ibid.). This tension is solved by individuals moving between organizations and institutional demands as they are “left to work out technical interdependencies informally” (Meyer and Rowan, 1977, p. 357). The social aspects of institutions have thus been important from the start.

Institutions are commonly described on three levels: the individual, the organizational, and the field (Scott, 2014; Thornton and Ocasio, 2008). In project studies, the levels can be viewed as the technical (operational; individual), strategic (operational; both individual and organisational) and institutional (abstract; organisational and institutional field) (Morris and Geraldi, 2011). The technical level is easily quantified and understood through a regulative lens, as practical project issues can be identified and dealt with accordingly. The project requires more alignment on norms and culture-cognition on the strategic level, as this encapsulates project set-up and organising. The institutional level focuses on the home organisations and their capabilities to manage their involvement in projects.

From its beginnings in the 1950s, institutional theory has developed from concentrating on single organisations towards an interconnected view of interactions between institutions (Scott, 2014; Thomas and Hardy, 2011). The homogeneity of institutionalisation legitimizes actors adhering to said structures, ensuring their survival, while simultaneously impeding change (DiMaggio and Powell, 1983; Meyer and Rowan, 1977; Scott, 2014). However, institutions are in constant flux and development, with the normative, regulative and cultural-cognitive elements continuously interacting and influencing each other (Scott, 2014). Institutions are thus social creations, created by interaction (Powell and Oberg, 2018; Scott, 2014).

The construction industry is institutionalized (Hall and Scott, 2019; Holti, 2011; Kadefors, 1995), with long-standing professional bodies (Hall and Scott, 2019; Roselius, 2022) and a strong social identification with the profession (Löwstedt and Räisänen, 2014) guarding the norms and values within the field. Although geographical areas have cognitive-cultural differences, especially in regards to collaborative project delivery models (Lahdenperä, 2012), the strong technical and problem-solving identity of construction work facilitates isomorphism due to the powerful regulative presence within the field (Kadefors, 1995). Today, the project-based construction industry gathers different actors under a distinct project umbrella to achieve a single project goal by aligning multiple different actors, their goals and expertise (Lundin et al., 2015). Projects are coordinated and controlled activities, spanning multiple organizations and are shaped by the institutional environment of said actors (Matinheikki et al., 2019; Morris and Geraldi, 2011) as well as the political and public environment for public infrastructure projects (Dille and Söderlund, 2011).

Researchers have long advocated for viewing projects through an institutional lens (Biesenthal et al., 2018; Morris and Geraldi, 2011). These aspects are especially pertinent for megaprojects, which have a societal impact (Altshuler and Luberoff, 2003; Capka, 2004; Flyvbjerg, 2014) and thus both stem from a certain societal (institutional) context, but also have the inherent ability to change it. Moreover, since projects comprise of the collective efforts of several actors, they become an arena for institutional exchange and interaction as differing institutional understandings meet during the project process (Biesenthal et al., 2018).

3.2.1 Project as arena for change

The rise of institutional theory in both project management in general (Morris and Geraldi, 2011) and inter-organisational settings in particular (Dille and Söderlund, 2011; Sydow and Braun, 2018) highlight the need for a deeper understanding of the project network: the network's context shape the network and vice versa (Powell and Oberg, 2018). Network structure furthermore influences network actors (Battilana and Casciaro, 2012; Burt, 2001), and since the project creates the network, the interdependency between form and function become paramount.

Infrastructure delivery projects create a temporal inter-organisational entity (Jones and Lichtenstein, 2008; Lundin et al., 2015), based on familiar behaviours and norms (Loosemore and Tan, 2000; Löwstedt and Räisänen, 2014) as well as codes and regulations (Holti, 2011; Kadefors, 1995). Due to the number of stakeholders, the institutional interaction related to the project result in institutional complexity and exchange (Hetemi et al., 2021). Moreover, as megaprojects shape society (Flyvbjerg, 2014), they simultaneously shape their institutional context while interacting and being affected by it (Biesenthal et al., 2018; Qiu et al., 2019) and are thus interesting from an institutional point of view. Their organisation as a collection of sub-projects gathered under a programme umbrella (Denicol et al., 2020; Frederiksen et al., 2021) and temporary nature of the project (van Marrewijk et al., 2016), combined with complexities arising from both the scale of the project (Flyvbjerg, 2014), inter-organisational interactions (Jones and Lichtenstein, 2008), the uncertainty and risk of unique undertakings (Hobday, 2000) and the multiple institutional dynamics acting within (Matinheikki et al., 2019) make megaprojects challenging to deliver. Different variations of CPDM has been introduced with a view to tackle these challenges, such as alliancing in Finnish tunnel construction (Matinheikki et al., 2019) or the integrated program team of Crossrail in the United Kingdom (Davies et al., 2014).

The combination of these aspects –the inherent institutional exchange happening in projects in general, the institutional change resulting from megaprojects in particular, and the conscious introduction of a new project delivery model– posit a change process being created in interaction between the project and its context.

3.2.2 Institutional logics

The discussion regarding the institutional multiplicity within construction is active within construction project research (see e.g. Biesenthal et al., 2018; Bygballe and Swärd, 2019; Frederiksen et al., 2021; Qiu and Chen, 2022). This might be connected with the combination of viewing construction as a project-based industry and the concept of projects as institutional arenas (Frederiksen et al., 2021). The research stream has included studies on institutional work (Gluch and Bosch-Sijtsema, 2016; Lieftink et al., 2019), entrepreneurs (Hall and Scott, 2019) and logics (Frederiksen et al., 2021; Gluch and Hellsvik, 2023; Matinheikki et al., 2019). These perspectives reframe the discussion about institutional dynamics toward institutional transformation and the individual rather than organisational isomorphism (Glynn and D'aunno, 2023).

The inter-organisational interfaces characterising infrastructure delivery (Denicol et al., 2021; Jones and Lichtenstein, 2008) combined with the complexity and uncertainty of unique large-

scale projects (Flyvbjerg, 2014) makes the alignment of participating actors challenging; a key problem in public infrastructure projects (Brunet, 2021; Matinheikki et al., 2019). As the individual is a key actor in reconciling conflicting ideas and identities (Bévort and Suddaby, 2016), a perspective which takes both the individual and the larger context into consideration is a suitable frame. Due to the research questions and framing, I have focused on institutional logics rather than for example institutional work or institutional entrepreneurs.

Institutional logics are the contextual norms, values and behaviours that frame existence and action and “provide a link between individual agency and cognition and socially constructed institutional practices and rule structures” (Thornton and Ocasio, 2008, p. 101). Logics provide collective identities on all institutional levels (Bévort and Suddaby, 2016; Thornton and Ocasio, 2008), enabling a common understanding and identification (Glynn and D’unno, 2023; McPherson et al., 2001; Thornton et al., 2012). They are both symbolic and material, encompassing both the norms, ideas and values of the institution, but also created and upheld by the material world they exist in (Friedland and Alford, 1991; Lounsbury and Boxenbaum, 2013); the computer systems, organisation charts and collaboration agreements framing them. On the *individual level*, logics steer action and behaviour, creating a cohesive identity (Bévort and Suddaby, 2016). On the *organisational level*, logics shape goals and steer the actions of an organisation, depending on attributes such as market position and organisational type, professional identity and legal environment (Frederiksen et al., 2021; Matinheikki et al., 2019; Thornton, 2004; Thornton and Ocasio, 2008). On the *field level*, logics steer professional norms and values, determine legitimacy and control mechanisms (Frederiksen et al., 2021; Morris and Gerald, 2011; Thornton, 2004). Already Friedland and Alford (1991) recognised the need for a multi-level approach to institutions, as the interaction of the individual, organisational and institutional levels shape the context. There is moreover the *project level*, where these diverse logics meet.

Institutional logics steer behaviour, frame mental schema and help prioritise activities (Friedland and Alford, 1991; Thornton et al., 2012). Two interacting logics cannot be exactly the same – then they would be the same logic or, what amounts to the same thing, the result of convergent evolution and so almost interchangeable – and their interaction is thus, by definition, conflicted. As differing logics meet in a project organisation, conflict is therefore to be expected. The severity thereof depends on the differences and context. The main competing institutional forces in infrastructure delivery projects are *bureaucratic*, *corporate* and *professional* (Gluch and Hellsvik, 2023; Matinheikki et al., 2019; Thornton, 2004).

Bureaucratic (state): Infrastructure delivery is affected by the local political context due to the often public nature of such projects, as well as the regulative framework shaping the project itself (Denicol et al., 2021). Moreover, industry standards and routines, such as procurement processes and supply network organisation, contingent on the bureaucratic framework, may affect the project (Kadefors, 1995). The client is often in a position of power due to their background as a public organisation, embedded in the political context, while both design engineer and contractor act within the same bureaucratic sphere as the client.

Corporate (market): Corporate (market) forces affecting infrastructure delivery includes the legitimising power of the market itself (Brunet, 2021), supply chain dynamics (Denicol et al., 2020) and employment framework, and the participating organisations’ market power and position (Thornton and Ocasio, 2008). The client, often a public organisation in infrastructure delivery, acts as a service procurer (Denicol et al., 2021), while the design engineer and contractor act as service providers in the marketplace, their process defined by a project-based approach (Lundin et al., 2015). Corporate logic includes how the organisation acts and reacts to corporate ties, such as contracts and normative expectations, such as collaboration and trust. Moreover,

corporate logic can include how to act within the regulative framework, for example with regards to stakeholder rights and legal obligations.

Professional: Professional institutions include organisational and professional identities, the formal educational process and industry guilds and professional bodies (Thornton, 2004). While the contractor acquires their legitimacy through project participation (Löwstedt and Räisänen, 2014), the client and design engineer are mainly characterised by formal education and certifications, as well as membership in professional organisations who also produce their own materials, such as the Royal Institute of British Architects’ Plan of Work (Bravo and Bohemia, 2019), for example.

Table 3: Institutional forces affecting the actors (partly based on Hughes, 2003; Lundin, 2015; Matinheikki, 2019)

	Corporate	Bureaucratic	Professional
<i>Client</i>	Acts in the market space, procures services	Public actor or organization, acts in a space framed by state regulations	White-collar; bureaucracy; educated; iterative
<i>Contractor</i>	Project-based private firm, service provider	Acts in a space framed by state regulations	Blue- and white-collar; practical; linear
<i>Design engineer</i>	Project-based private firm, service provider	Acts in a space framed by state regulations	White-collar; bureaucracy; educated; iterative

Institutional pressures and conflicts between logics thus emerge when distinctive norms, values and behaviours interact (Lin et al., 2021; Matinheikki et al., 2019). The interaction of institutional logics can take several forms, the most common of which relate to interaction of logics in the form of hybridisation, dominance, co-existence and emergence of new logics (Frederiksen et al., 2021; Gluch and Hellsvik, 2023; Perkmann et al., 2019; Reay and Hinings, 2009; Thornton, 2004). As hybridisation relates mainly to permanent organisations (Perkmann et al., 2019), I have excluded this train of thought from the theoretical framework.

Earlier research suggests strategies to relieve tensions of conflicting logics through compartmentalisation or co-existence (Reay and Hinings, 2009), the emergence of a singular dominant logic (Frederiksen et al., 2021) or, alternatively, an ongoing switch between competitive and collaborative logics (Winch and Maytorena-Sanchez, 2020). Dominance can be either actor specific or dependent on a specific organisational space (Frederiksen et al., 2021; Reay and Hinings, 2009). Actors have their own institutional background which influences their perception of the project. These backgrounds may come in conflict and although logic negotiation and combining enable co-existence (Gluch and Hellsvik, 2023; Reay and Hinings, 2009), one logic may come to dominate the organisation. When dependent on an organisational space, differing logics may enable the simultaneous existence of several separate goals and understandings, such as the difference between the corporate logic guiding the steering group and organisational level, to the professional logic guiding the delivery team (Frederiksen et al., 2021).

Recent studies show another option: the development of a new institutional logic, created through the interaction in the project and appropriate governance structures (Matinheikki et al., 2019). Thus, relational governance might alleviate the challenges and complement the project’s contractual aspects (Lin et al., 2021; Poppo and Zenger, 2002). For example, Gluch and Hellsten (2023) discuss how construction professionals act in contexts defined by multiple logics, while Matinheikki et al (2019), show how a temporal organisation manages to create new logics through appropriate governance structures, although the long-term impacts on field-level logics is uncertain without field-level acceptance.

The different approaches to institutional logics are part and parcel of everyday life in both organisations in general and projects, the nexus for different logics, in particular. However, in an institutionalised project-based industry such as construction, the stability provided by institutions easily turn to inertia and thus become barriers to change and the new logics required by the introduction of new project management models.

3.3 The interplay of project networks and institutions

Recently, literature has delved into the interaction between institutional theory and network theory (Powell and Oberg, 2018). However, few have done so empirically. Project networks can be viewed as social frames for organisations and institutions, where new forms of organising, practices and processes are tested to then be incorporated into the static home organisation (Barley, 1986; Meyer and Rowan, 1977; Powell and Oberg, 2018; Tukiainen and Granqvist, 2016). According to Powell and Oberg (2018), social network analysis can help understand the forces shaping institutions, such as information flows, how legitimacy consolidates, and practices propagate. Social relations thus help spread the myths of the institution while institutions shape networks and institutional logics especially can help explain network dynamics (DiMaggio and Powell, 1983; Meyer and Rowan, 1977; Powell and Oberg, 2018).

The interaction of project participants create a project network within the project organisation, where multiple actors, with their own goals, strive to align those with the aims of the project (Adami and Verschoore, 2018; Hellgren and Sjörberg, 1995). This is an especially important aspect of megaprojects, where inter-organisational relationships play a key role (Guo et al., 2020; Jones and Lichtenstein, 2008). Furthermore, the governance structure (Pryke, 2005) and commercial model chosen, in tandem with the prevailing institutional setting (Powell and Oberg, 2018) influence actor actions in the project. A project network is thus the informal social relations created by the formal framework of the project as defined by a contract (Hellgren and Sjörberg, 1995). The project network is therefore also shaped by the surrounding legal framework, social norms and cultural understanding of the project's participants.

This multiplicity of drivers, coupled with the move towards collaborative project management models (Lahdenperä, 2012; Pryke et al., 2017; Walker and Lloyd-Walker, 2015) and the inter-organisational aspect of project networks (Jones and Lichtenstein, 2008; Sydow and Braun, 2018) highlight the relational dimension of the project network. The growth of projects and move towards CPDM as a delivery model thus introduce changes in the institutional context of infrastructure delivery projects.

The interaction of networks and institutions have been highlighted by recent research (Battilana and Casciaro, 2012; Powell and Oberg, 2018; Wang et al., 2018; Zheng et al., 2016). Powell and Oberg (2018) further argue for a deeper understanding of how networks and institutions interact by analysing multiple types of organisations. Since social ties enable the flow of demand and expectation between nodes in a network (Powell and Oberg, 2018), they can facilitate changing institutional roles by social interaction. Social network analysis can thus be used to understand institutional processes (Powell and Oberg, 2018). A further focus on project networks can help us understand the institutions surrounding temporary organising in inter-organisational settings.

The challenge in there is some of those can flip and can become farmer leaders, which is about nurturing your team; to develop them to enable them to deliver the project, versus “Follow me, charge!”

- Collaboration coordinator, client

4 METHODOLOGY

This chapter describes the research design and chosen methods for data collection and analysis. The chapter concludes with methodological considerations and reflections on research quality.

4.1 Research approach

The physical results of major infrastructure projects exist out in the world, in the shape of tunnels, bridges and public transportation systems. I view the existence of the project process, meant to deliver the end result, dependent on the collective experience of it, shaped by both the project and the project participant's social context (Alvesson and Sköldbberg, 2017; Lundin et al., 2015). The process can of course be made tangible and quantified by for example measuring meeting minutes or counting e-mails sent and designs approved (Ketokivi and Choi, 2014), or the network by mapping out the relationships, but to understand the project we must understand the social reality created and constructed: how people view reality is shaped by their understanding and the social context, understanding reality and creating knowledge thereof requires experience and making sense of how others view the world (Scott, 2013). A qualitative research approach is thus suited to understand this perspective (Ketokivi and Choi, 2014). From an institutional perspective, qualitative research can help achieve a deep understanding of the individual understanding of the norms, behaviours and expectations underpinning institutions (Glynn and D'aunmo, 2023; Scott, 2014). Case studies are a commonly accepted method in the field.

My research is thus based in qualitative research both from the phenomenon itself, as well as the network perspective and institutional perspective (Clegg et al., 2016; Loosemore et al., 2020). The work is empirically driven with the aim of elaborating on existing project delivery models and organisational theories (Fisher and Aguinis, 2017; Gioia and Pitre, 1990; Ketokivi and Choi, 2014; Van Maanen et al., 2007) regarding project networks and their institutional context (Powell and Oberg, 2018; Söderlund and Sydow, 2019; van Marrewijk et al., 2016).

The theoretical framework used in this work are based on particular perspectives on the world which come with implications regarding the research process. As institutional theory is based on interpretations and the negotiated reality of common norms, values and regulations, my work can be said to belong to the constructivist stream in the philosophy of science (Alvesson and Sköldbberg, 2017; Bell et al., 2019). The implications regarding ontology require me to consider how my research participants understand their reality and the social construction of, for example, 'projects'. Theory helps researchers make sense of the world (Bacharach, 1989; Fisher and Aguinis, 2017; Klemke et al., 1998; Merton, 1942), although recent publications have argued that theory easily becomes a constricting 'straightjacket' as scientific contributions are viewed in relation to already existing theories rather than as forays into the unknown (Schwarz and Stensaker, 2014). Van de Ven (2016), in reflecting on previous discussions regarding problem- and theory driven research, argues for a balance and reflective stance from the researcher on the intended audience. This aspect is especially important in phenomenon-driven research, as the research process is more iterative than in clearly inductive or deductive research (Schwarz and Stensaker, 2014; Van de Ven, 2016). A researcher must thus be reflexive and recognise the 'known unknowns' in order to define the phenomenon and contribute to the scientific discourse (Alvesson and Sköldbberg, 2017; Van de Ven, 2016). This ongoing discussion highlights the evolving nature of theory as it changes with the times and its particular context (Meadows, 2009; Merton, 1942) and need further elaboration to apply it to current phenomenon.

How people interpret project networks and organisations is of interest as their understanding of them evolves in tandem with the development of their worldview. Social structures, like institutions and networks, both guide and constrain actions, which in turn can influence the aforementioned structures. Thus the project network likewise exists as a social construct (Adami

and Verschoore, 2018; Hellgren and Stjernberg, 1995; Pryke et al., 2017) and although quantitative approaches have been the vogue in network research over the last decades (Clegg et al., 2016), a qualitative approach can help us understand network dynamics (Clegg et al., 2016; Loosemore et al., 2020). According to Clegg et al. (2016), networks are often viewed as fixed and rigid: a process-based perspective and understanding of the collective action that creates the project, rather than the snapshot in time provided by a purely network-based perspective, can help clarify theoretically relevant phenomena.

The work uses the examined cases as a springboard to understand the phenomenon of CPDM in project delivery. The data corpus includes a pre-study and four case studies: one in Finland, two in Sweden and one in the United Kingdom and was continuously discussed with both a reference group and a steering group consisting of experts from industry and academia. The research origin is thus found in the empirical material, and I am moving back and forth between it and theory. I seek to combine project networks and thoughts on the institutional context to understand CPDM as applied to infrastructure projects. The parsed empirical data was used as a starting point for abductive analysis, from whence a back-and-forth movement between empirical data and theory started. This non-linear and iterative process is characteristic for abductive research (Dubois and Gadde, 2002; Van Maanen et al., 2007).

Nonetheless, the social creation of the research context comes with caveats. I as a researcher am subjective and interpretative, bringing my own perspective into the research (Bell et al., 2019; Klenke et al., 1998; Merton, 1942). As our common perception of reality is negotiated between researchers and respondents, as well as within the scientific community and the industry (Alvesson and Sköldbberg, 2017; Bell et al., 2019; Brinkmann and Kvale, 2018; Merton, 1942), I thus accept the current understanding of projects, organisations and networks.

4.2 Research design

A literature study was conducted at the start of the research process, which was kept up to date throughout the process. A multiple case study was chosen as a suitable approach to develop an understanding of the phenomenon as the framework provided thereby facilitates contrasting, replication and theory development (Eisenhardt and Graebner, 2007; Flyvbjerg, 2006; Yin, 2003). Moreover, as theory elaboration seeks theoretical understanding by abstraction of empirical data, while grounded in the case context (Ketokivi and Choi, 2014), a multiple case study is a suitable method to understand the studied phenomenon from the perspective of project practitioners and develop theory (Bell et al., 2019; Eisenhardt and Graebner, 2007; Ketokivi and Choi, 2014; Yin, 2003). For this type of case-based research as theory elaboration, abductive research is recommended (Dubois and Gadde, 2002; Ketokivi and Choi, 2014). Moreover, the focus on relational data makes networks especially suitable for empirical research (Shi et al., 2022).

As I am studying project delivery, correct timing of the projects was paramount. The selection criteria were thus as follows. The case projects should preferably be in phase two, delivery, but not too close to finishing so phase one can still be recalled. They should be classified as megaprojects in their context, with sufficient levels of complexity, size, duration and impact on society (Flyvbjerg, 2014; Söderlund et al., 2017). They should furthermore be infrastructure projects with a public client.

The projects chosen for the case studies are suitable in relation to the purpose of developing a deeper understanding of how the CPDM model is used in practice. Since delivery differs between projects and infrastructure projects are especially unique, it is difficult to find one exemplifying case project to focus on (Flyvbjerg, 2006) which is why I focused on greater

generalisability through a multiple-case study of four projects. The case projects chosen were suitable in regard to the timing of their process and accessibility.

The research was divided into two parts. In the first part, a pre-study precluded two main case studies, case I and II. In the second part, two main cases were conducted, case III and IV. The design of the first and second case study was inductive, although it turned abductive as the decision to use the social network view emerged during the study. The validation of research themes provided by the pre-study helped to focus on the project network. The findings, combined with further literature review, changed the focus somewhat for case study III and IV, with a heightened focus on the key actors and collaborative practices.

In the beginning of my research I used search terms related to ‘construction’ and ‘collaboration’ which led me to a starting point for snowballing (Bell et al., 2019). Through continuous reading of pertinent literature, both academic and industry-focused, and attending seminars and conferences, my overview of the field developed. The literature review focused initially on construction management and project management literature. The focus on collaboration quickly directed the search into network literature and further into project networks. Through the field of project networks and relationships in projects, my research focused on social aspects of the project as well as identifying the project network.

In the second half of my research, with the introduction of institutional theory, the focus also shifted more into looking at the multi-level perspective of projects and actors. The initial stage of my research is presented in my licentiate thesis (af Hällström, 2021). The research can thus be said to have developed from focusing on collaboration within the Swedish infrastructure industry in general to a more specific look at the changes the use of CPDM invites in project organising; to include a multi-level approach to projects, international perspectives and a wider conceptualisation of collaboration, including cooperation and coordination. The pivot towards institutional theory led me to re-examine previously collected data through norms and common rules, as well as emphasizing aspects related to common processes and ways of work.

Although the themes sharpened during the research process, the main theme of collaboration and change was consistent, as was the individual’s perspective on the project. Table 4 presents an overview of the studies included in this thesis.

Table 4: Overview of case studies included in the thesis

	<i>Pre-study</i>	<i>Study I</i>	<i>Study II</i>	<i>Study III</i>	<i>Study IV</i>
<i>Data collection</i>	Three interviews with project managers from main actor organisations; webpages and news reports	20 interviews with project managers from main actor organisations; project documents; webpages and news reports	24 interviews with project managers from main actor organisations; project survey results; project documents; webpages and news reports	16 interviews with project managers from main actor organisations; project documents; webpages and news reports	17 interviews with project managers from main actor organisations; project documents; webpages and news reports
<i>Time of study</i>	February 2019 – March 2019	May 2019 – December 2019	August 2019 – April 2020	August 2021 – (ongoing)	May – August 2022

4.3 Data collection

Empirical data was gathered through conventionally accepted methods: interviews, observation and document analysis (Bell et al., 2019). Furthermore, a project network was constructed for case studies I, II and III based on interview responses.

Interviews were conducted with respondents gathered through snowball sampling (Bell et al., 2019). The interviews were between 30 minutes and three hours in length and were mainly conducted in person. Due to restrictions on in-person meetings during the Covid pandemic in 2020 and 2021, most interviews at case study III were conducted online. An interview guide was developed in the pre-study and subsequently used for case studies I and II. The guide was modified slightly for case study III and further for case study IV. Themes discussed included the different project phases, the respondent's view of the project in general and their own role in particular, benefits and challenges in the project, as well as the definition of collaboration and what animal the project most resembled. Respondents represented all levels in the project hierarchy, from project manager to design leader and construction specialists. I kept hand-written notes during the interviews. The respondents were furthermore asked for their consent to tape the interviews. All respondents bar one consented and thus all interviews bar one were taped. Two interview recordings were unfortunately lost during the process. The interviews were then transcribed. Table 5 shows an overview of the respondents.

Table 5: Interview respondents

		<i>Case I</i>	<i>Case II</i>	<i>Case III</i>	<i>Case IV</i>	<i>Total</i>
	Client	8	5	7	3	23
<i>Client</i>	Collaboration coordinator	1	-	1	1	3
	Director	1	1	2	1	5
	Manager	5				5
	Project manager	1	1	1	1	4
	Specialist	-	3	2	-	5
	Project sponsor	-	-	1	-	1
	Contractor	8	9	4	10	31
<i>Contractor</i>	Collaboration coordinator	-	-	-	1	1
	Director	3	2	3	5	13
	Manager	4	4	1	3	12
	Project manager	1	1	-	-	2
	Specialist	-	2	-	-	2
	Project sponsor	-	-	-	1	1
	Designer	4	7	5	2	18
<i>Design engineer</i>	Collaboration coordinator		1			1
	Director	2		3	1	6
	Manager	2	3	2	1	8
	Project manager	-	2	-	-	2
	Specialist	-	1	-	-	1
	External	-	3	-	2	5
<i>External</i>	Director	-	-	-	1	1
	Other	-	-	-	1	1
	Project manager	-	1	-	-	1
	Specialist	-	2	-	-	2
	Grand Total	20	24	16	17	77

Observations (Bell et al., 2019) were conducted at the project offices of case study I and II. An observation guide was developed with the supervising team and the observer was seated at the project office for two full working days in case study I and five full working days in case study II. Due to the Covid pandemic in 2020 and 2021 planned observations could not be realised in case study III. The project offices of case study IV were observed briefly and informally during a study visit to the project. Observations focused on interpersonal relations and social exchange, as well as the atmosphere of the collocated office and the daily use of the space.

Network pictures (Albert and Barabási, 2002; Battilana and Casciaro, 2012; Pryke, 2005; Scott, 2013) were constructed at case study I, II and III. At case studies I and II the social network was based on respondents' ranking of their closest colleagues. In case study III, the network was further segmented by whom of their closest colleagues the respondents worked the most with. As case IV focused on the leadership team, a project network was not visualised in this case.

Documents were obtained from the projects and publicly available sources in all case studies. Documents from the projects included organisation charts, process descriptions and memoranda. External documents included news items and opinion pieces, the projects and participating organisations' web pages, and media communiqués.

4.4 Data analysis

Interview data was initially transcribed. In the case of interviews in either Swedish or Finnish, I did the transcription myself, except for 18 interviews who were initially translated by a service provider. In the case of interviews in English, the initial transcription was done by an AI-powered webpage (otter.ai) and the resulting text was then proofread. Thereafter the empirical data was imported into the software NVivo.

The text was read through, and sentences mapped inductively according to emergent codes. Some sentences covered several codes and were mapped accordingly. The codes were then organised into overarching themes, including findings from observations and document analysis. The coding process was developed and refined several times as the research progressed according to new themes emerging and new theories applied to the findings. The initial findings from the pre-study were used to inform the interview guide of study I and study II, which in turn informed a developed interview guide for study III and IV. Observations confirmed the interview data. Coding thus followed an abductive process as it was done and re-evaluated after each case study. The largest change happened when the second project phase started, between cases II and III, and the focus shifted towards institutional logics. At this point, I returned to my first interviews and re-coded them with respect to institutional theory and logics.

Observation data, which consisted of observation notes, photographs and sketches, was scanned or transcribed, as applicable, and loaded into NVivo. The text was read through, and sentences mapped inductively according to emergent codes. Some sentences covered several codes and were mapped accordingly. The codes were then organised into overarching themes, including findings from interviews and document analysis. The coding process was developed and refined several times as the research progressed according to new themes emerging and new theories applied to the findings. Document analysis and interviews confirmed the observations.

Documents were loaded into NVivo. Coding of the data according to concepts enabled theme discovery. The documents were read through and mapped inductively according to emergent codes. Some document data covered several codes and were mapped accordingly. The codes were then organised into overarching themes, including findings from interviews and observations. The coding process was developed and refined several times as the research progressed according to new themes emerging and new theories applied to the findings. Interviews and observation confirmed the document analysis.

Social networks were created for cases I, II and III based on strong ties between respondents. I have followed Granovetter’s seminal definition from 1973 of strong ties in this work: as a combination of the time, individual emotional input, mutual trust, and reciprocity characterizing the tie’s strength. Since many of these aspects are highly subjective and as relational data is created in interaction (Scott, 2013), I have relied on the respondents’ lived experience of ‘strong ties’ in their context when creating the include network pictures. The respondents were asked who their closest colleagues were and who they worked with the most. The relationship data was then coded with the programming language R, creating networks based on interview data. Key measures for network structure were transitivity, density, clustering, average path length. Key measures for actor position were degree closeness, betweenness, eigenvector centrality and closeness. See Table 6 for key figures related to the networks compiled. Observations supported the network analysis.

To answer recent calls for a more qualitative approach to network theory (Clegg et al., 2016; Loosemore et al., 2020), I have chosen a qualitative approach to project networks (Adami and Verschoore, 2018; Ahola, 2018; Hellgren and Stjernberg, 1995; Matinheikki et al., 2019). I will thus be studying *network effects*, that is *analysing* the network, rather than theorizing about the network and its formation or disintegration (Brandes et al., 2014). Although these values and network pictures generated are a ‘snapshot in time’, the interview responses have given depth and a longitudinal character to them that enables a deeper understanding of the multi-level nature of project networks and their internal dependencies.

Taking a network view often places undue focus on the network as the static entity collected at one point in time, losing the dynamics of the network (Clegg et al., 2016). A qualitative approach to networks can help us understand both how the network changes and the consequences thereof (Loosemore et al., 2020).

Table 6: Key figures for the social networks in cases I, II and III

	<i>Transitivity</i>	<i>Density</i>	<i>Clustering (modularity)</i>	<i>Average path length</i>
Case I	0,3913043	0,03717949	0,5300706	2,565217
Case II	0,1421801	0,04207317	0,2373486	5,367347
Case III	0,384	0,0439408	0,1457177	6,883549

Table 4 presents the case studies contributing this thesis. Table 5 shows an overview of interview respondents. Table 6 displays the key figures for the studied social networks. Table 7 presents an overview of the included papers.

4.5 Research quality

4.5.1 Trustworthiness

Qualitative research studies should be *credible*, *transferable*, *dependable* and *confirmable* (Bell et al., 2019). I base this section on the writings of Bryman, Bell and Harvey (2019).

Credibility focuses on whether the study’s findings are correct and accurate. It can be heightened by triangulation, prolonged engagement with data and external audits. I have strived for triangulation of data by using multiple data sources (interviews, observation, document analysis), the engagement with the data has been intense and prolonged and an external reference group has been involved in validating the research findings.

Transferability includes the transfer of research results to other contexts. Since case studies by nature are context-bound, transferability becomes a paramount concern. I have strived for transferability by using thick descriptions and providing rich descriptions of the case studies.

Dependability measures internal consistency and reliability of research results. It includes cataloguing data collection and analysis methods used, as well as providing contextual information about the study for possible future replication. I have strived to keep note of data collection and analysis methods and the research has been extensively discussed with both supervisors and external reference groups to ensure dependability.

Confirmability includes researcher neutrality and letting the data speak for itself. I have strived for confirmability by keeping note of data analysis and codes used to ensure accurate portrayal of respondent's views.

The overall research design used triangulation of interview data, documents obtained from the case studies and openly available on the internet and expert validation to ensure the validity of both the research design and findings (Bell et al., 2019).

4.5.2 Ethical considerations

Case research should be transparent and methodologically consistent (Ketokivi and Choi, 2014; Yin, 2003). Transparency (Ketokivi and Choi, 2014) is nevertheless difficult to reconcile with respondent confidentiality (Bell et al., 2019), a cornerstone of qualitative research. Since qualitative research consists of mutual knowledge creation (Bell et al., 2019; Brinkmann and Kvale, 2018; Scott, 2013) and my research context involves proprietary information about both national projects as well as company information, both respondent anonymity and confidentiality as well as data management becomes important from an ethical standpoint.

Access to the case projects was obtained through the research project's steering group as well as through personal connections. There might therefore be conflict of interest in the case selection. This risk was mitigated through detailed discussion with the supervisory team, steering group and reference group when deciding on which case projects to approach and include in the study. Moreover, since megaprojects are, although increasing in number, still rare, the access also formed a limitation.

I obtained informed consent and ensured confidentiality for interview respondents. I furthermore strived to make the interviews positive experiences for the respondents (Brinkmann and Kvale, 2018). Since the respondents might discuss sensitive information, anonymity is important also when presenting the cases in peer reviewed publications both on individual as well as project level.

For observations, permission was sought and obtained from the project manager and/or leadership team, as appropriate, thus ensuring the project's knowledge and acceptance of the times of observation.

4.6 Reflections on the research process and limitations thereof

Science is embedded in our society and shaped by history; already accessing the readings for this thesis has proven how dependent we are on this context. My worldview (my values and the norms that I live by) is further defined as what I can conceive off. To stay wilfully blind to our own assumptions and biases and to hide behind scientific methods, without accounting for the personal beliefs of the researcher, is an antithesis of science.

To reflect upon my own position; my research project is very much directed and framed by my own values and look on life, as well as the wishes and institutional practices of both the university and the financiers of my project. I do gather knowledge to learn more about the specific

phenomenon I am investigating, but I also do it to further my own, personal goals. Merton and other philosophers of science might turn in their graves, but it is a select few who can seek knowledge for the pure joy of investigating the world.

Qualitative research in general and case studies in particular are used to gather deep insight into specific phenomenon and generate novel theoretical insights (Fisher and Aguinis, 2017; Gioia and Pitre, 1990; Ketokivi and Choi, 2014; Yin, 2003). Considering the research project as well as my aims and skillsets, a qualitative approach was the most suitable in this situation, although I wish to develop my quantitative skills in the future. However, the chosen methods do have their limitations (Bell et al., 2019; Brinkmann and Kvale, 2018). Especially case study III was furthermore impacted by the Covid-19 epidemic, which restricted interviews, observations and data validation by the case studies themselves.

Interviews were conducted during one project phase which limits the generalisation of data. The context dependent mutual knowledge creation, framed by a power asymmetry between me as an interviewer and the respondent (Brinkmann and Kvale, 2018), impacts the interview data. Due to snowball sampling, I might have focused on too narrow a band of respondents (Bell et al., 2019; Brinkmann and Kvale, 2018). Could I start over, I would focus more on ensuring a broader coverage of respondents, especially of project sponsors in the home organisations.

Observations were conducted during a limited time at the main project offices. Since not all actors were there at the particular moment in time, the data obtained reflects the current interactions. To mitigate this, respondents and the reference group was asked to evaluate the observation data. In future studies I might focus more on observations and ethnography to better see the day-to-day practices in the project, which constitutes a core part of relational interaction, rather than relying on interviews for network information.

Documents were obtained from publicly available sources, which skews them towards client documents due to requirements for public clients to provide public information about their projects. The documents obtained from case projects were selected by the projects, which might have skewed the data obtained therefrom in a direction wished for by the document providers. To mitigate this, respondents and the reference group was asked to evaluate the document data. In the future, I would strive to obtain an equal proportion of documents from the service providers respective to the client.

The *qualitative network* is based on self-reporting and might thus exclude nodes not thought of in the moment. However, since the focus is on the perceived network rather than the most frequent interactions, this risk was deemed minor. The participants had a possibility to complete their network maps later on and the networks were evaluated during their construction. For future studies, I would focus on collecting external relational data, such as e-mail correspondence, to compare the self-reported network with the practices exhibited in the project.

My character has also impacted how I frame this research. To counter this, the interview guide and observation guide have been discussed with my supervision team at multiple occasions. A further mitigation measure to counter this risk was to triangulate data and ensure that all actors and all organisational levels were represented among the respondents.

5 RESULTS

This chapter summarises the papers included in this thesis. Each paper is presented by its aim, theoretical framework, main findings and key implications for theory and practice. In the end, I present an overview of the case-related findings.

Table 7: Overview of papers included in the thesis

<i>Paper</i>	<i>Main analytical framework</i>	<i>Empirical material</i>	<i>Related research questions</i>
<i>Paper I</i>	Project network theory	Study I, Study II	RQ1
<i>Paper II</i>	Boundary spanning roles/ roles, project network theory	Study III, Study I and II	RQ1, RQ2
<i>Paper III</i>	Project network	Study I, Study II	RQ1, RQ2
<i>Paper IV</i>	Institutional theory + project network theory	Study I, Study II	RQ2, RQ3
<i>Paper V</i>	Institutional change	Study IV, Study I and II	RQ1, RQ2, RQ3

5.1 Paper I

The role of social ties in collaborative project networks: A tale of two construction cases

Aim and purpose: The aim of the paper is to broaden the understanding of social ties within project networks created in projects adopting a CPDM. More specifically, the purpose of the study is to investigate the role of social ties in projects managed by a CPDM. The paper answers the following research question: *What is the role of social ties in projects using a CPDM?*

Research design: The social network forming the basis of project network is constructed by data gathered from semi-structured interviews in case studies I and II.

Main findings: The empirical paper shows how differences in the adoption of CPDM lead to differing levels of social ties and network structures. The network is initially based on the formal framework provided by the project contract(s) but evolves during the project process into informal ties. The results furthermore identify four aspects influencing network formation: (1) the initial setup and project identification; (2) resource sharing; (3) a co-located project space; and (4) expectations of other actors' roles.

The paper extends the understanding of social ties in project networks, revealing differences between social ties depending on differing implementation of CPDM. Aspects influencing the development of social ties includes the initial set-up, collective project understanding, sharing resources and project offices, as well as the understanding of and expectations of the roles of other participants. The paper moreover emphasizes the change in which ties are important throughout the process, changing from an initial reliance on formal ties to informal ties when the project network becomes established, enabling information flow and collaboration.

The results moreover show how the interaction of formal and informal ties with the project network, emphasizing the importance of a balance between contract and participants.

Key implications for theory and practice: The paper contributed to a deeper understanding of social ties in project networks. Utilising a qualitative approach, the paper furthermore contributed to the understanding of relational network aspects. On a practical level, the paper shows how a

project moves from contract to social interaction, as well as identifying points of action when project managers can influence the network.

Relation to the research: The paper discusses social ties in CPDM projects and the part they play. The paper is connected to case study I and II.

5.2 Paper II

Who influences collaboration?

Gatekeepers and key actors in major public infrastructure projects

Aim and purpose: The paper answers the call for a better understanding of the role of individual actors in project networks (Pryke et al., 2017) and the call of Adami and Verschoore (2018), who called for “studies linking aspects of informal governance with project performance” (p.84). We furthermore aim to contribute to the literature on project delivery in the infrastructure construction sector, with a focus on deepening the understanding of key actors as well as ‘hidden’ project roles within the project network, thus challenging the established truth of key actors in construction projects.

Research design: The paper was based on interview data and observations collected from case studies I, II and III.

Main findings: The paper analyses changing roles within CPDM-managed projects with a focus on the key actors and “gatekeepers” within the project. Although the paper does mainly confirm earlier research on the importance of the project manager’s role and leadership, the multiple case study highlights the role of the ‘expert administrator’ roles in the project network, a role thus far less investigated in literature. The results moreover challenge the established role of collaboration coordinator: While this role is often declared important in CPDM literature, the role did not show up in the networks as a node, requiring a new way of approaching project organisation design to achieve collaborative projects. The paper moreover focuses on the qualitative data gathered about the project network, broadening our understanding of network ties.

Key implications for theory and practice: The research expands on the literature on actor roles within CPDM projects, with an emphasis on the ‘expert administrator’ role. However, the often-lauded role of collaboration coordinator did not appear as important as expected. The paper also presents an empirical application of qualitative social network analysis which is a rare form of analysis thus far. The results contribute to our understanding of network structure and how the social network contributes to inter-organisational collaboration within the project.

Relation to the research: The paper focuses on a multi-level approach to collaboration and the interplay between network and institutions. The paper is connected to study I, II and III.

5.3 Paper III

The weakness of strong ties influencing collaboration in project networks

Aim and purpose: The paper aims to understand the consequences of strong ties in project networks. The following research question was answered in this paper: *What are the weaknesses of strong informal ties in inter-organizational megaprojects?*

Research design: The paper was based on interview data and observations collected from case studies I and II.

Main findings: The empirical paper focused on consequences of strong social ties for the project network. In long-term projects, such as infrastructure delivery a certain degree of actor change

will happen due to personnel changes and organisational changes. When strong ties form in a project network, it becomes difficult for new actors to enter the network, both individual and organisational, constricting network exchange and renewal. The paper provides empirical evidence of the nature of different ties and how they interact within a project network to create a mutual understanding between the people within the in-group.

Key implications for theory and practice: The paper contributes to the concept of ties and their characteristics in network theory. The paper moreover contributes empirical evidence on the impact of strong ties on project networks and the barriers for entry they present. This challenge must be taken into account when planning long-term CPDM projects where a certain amount of actor change is inevitable. The paper moreover contributes to a better understanding the benefits and challenges of CPDM in practice, as it highlights the entry barrier to the project network created by strong ties.

Relation to the research: The paper analyses the effect of strong social ties, highlighting the restrictions it places on a collaborative project organisation. The paper is connected to study I and II.

5.4 Paper IV

**The influence of network ties on changing project delivery implementation.
A study on two Nordic infrastructure projects.**

Aim and purpose: The paper uses a perspective grounded in institutional theory to analyse two project networks and the changes to the institutional context introduced by the adoption of novel project management models. The following research questions form the core of the paper: *How do network ties influence institutional change in inter-organisational projects?*

Research design: The paper was based on interview data and observations collected from case studies I and II.

Main findings: The findings of this empirical paper show how the implementation of a CPDM can lead to institutional changes related to organisational, project and individual levels among the three main actor roles of client, contractor and design engineer. However, an unsuccessful implementation can impede the change and hinder the adoption of role behaviours necessary for collaborative practices. To succeed with the intended change shift, the project needs a unified understanding of responsibilities, identity and goals of the project.

There are also differences in network structure on the flow of resources within the project which shapes the collective creation. A cohesive network helps with trust-building within the project organisation, while a bridging network can assist in work focused on specified parts of the project. In the cohesive network, information spread quickly and actors discussed new challenges together, while in the bridging network, participants were more isolated from each other and had differing expectations of each other and responsibilities within the project. The focus on the project network gave insight in the structure of the network and the relationships between the different actor roles and how the network can change established institutions. The study shows the influence of network structure that can influence the flow of information and communication in a project network, enabling or hindering the adoption of new delivery models and roles. In this respect, a cohesive network structure can help create a unified project identity and thus facilitate the transition to new roles and routines needed in the changed context.

The findings moreover show the differences in participant engagement and how roles evolve, either challenging or supporting the implementation of the new project model. A single project identity combined with a single multi-party contract can help in aligning the separate expectations

from the inter-organisational participants, easing the development of new roles and understandings as well as the unified project perception.

The client role was seen as in need of the greatest change, both in process and practice. The client representatives faced daily participation in the project, as opposed to their familiar process of arm's length control and supervision. Since the contractor needed to participate in the early project phases, they needed to re-evaluate their view of the project process and how they should participate. The design engineer on their part needed to adjust to receiving early input from both client and contractor as well as new work processes due to the principle of co-location, important to the successful application of CPDM.

Key implications for theory and practice: The study contributes to a deeper understanding of the interrelation between project networks, network ties, and institutional change. The study contributes to the empirical evidence of the interplay between project networks and changing institutionalised roles in inter-organisational megaprojects. The study moreover highlights the changing project process and the practical impact of both formal and informal network ties on the project organisation as well as participating organisations and individuals.

Relation to the research: The paper focuses on the effect implementing CPDM has on roles and expectations in a project. The paper is connected to study I and II.

5.5 Paper V

Clash of clans: Empirical evidence of conflicting institutional logics and their impact on megaproject collaboration

Aim and purpose: The aim of the paper was to answer the call for further empirical studies into megaproject management and add to the field of institutional theory by investigating conflicting logics in a megaproject by the following research question: *What conflicting institutional logics manifest in collaborative megaproject organizations and how do project actors mitigate these?*

Research design: The paper was based on interview data and observations collected from case studies I, II and IV.

Main findings: The paper explores the new reality facing megaprojects utilising a CPDM, emphasising inter-organisational collaboration. The paper focuses on conflicting institutional logics within projects using a CPDM, arising due to the inter-organisational nature of megaprojects. These models act as institutional arenas for logic interaction and require novel logics of participating actors due to the involvement of all key actors in early project phases, shared tools and responsibilities. The paper gives evidence for changing institutional logics when projects manage to apply a CPDM successfully. However, there is a risk of resistance and a return to traditional logics since institutional change is slow and an unsuitably applied CPDM can lead to adherence to the conventional way of work.

Key implications for theory and practice: The paper contributes to the literature on and develops the theoretical concepts of institutional logic and change. The paper also provides empirical evidence of the institutional forces affecting megaprojects and the changing nature of projects applying a CPDM. The findings contribute to better project organising and management through deeper understanding of origins of conflict and gives an overview of infrastructure delivery, processes and relationships.

Relation to the research: Deep insight from a single case study, contrasting findings with Nordic setting. The paper is connected to study I, II and IV.

5.6 Case-related findings

5.6.1 Pre-study

The pre-study investigated a completed railway renovation project close to Stockholm. The client deemed the project a success as it was completed within schedule, timing being the greatest risk in the project. Three interviews were conducted with representatives from the client, the contractor and the design engineer.

5.6.2 Case study I

Case study I focused on a megaproject in one of the five largest Nordic cities, remodelling a central railway station and building new train tracks. The project used Early Contractor Involvement as their CPDM approach, with the client using a traditional contract with the main contractor who subcontracted all other work, including design.

The project started in 2014 with project development and procurement, followed by phase 1, planning and design, in 2016 and phase 2, detailed design and construction, in 2018. The client expects the project to be delivered in 2026. The monetary value of the project is approximately 470 million euro, or five billion SEK.

The main actors, client and contractor, strived to mirror each other's project organisations. The project used a common document platform and a main project office as well as block offices, with seating for both client and contractor, as well as 'floating desks' for occasional guests during phase 1. During phase 2, the contractor moved partly out to offices at the construction site. The design engineer attended the office mainly for meetings. The project lacked a unified project identity and was characterised by conflict and differing understandings of the project goals. The project was moreover perceived as a traditional design-build project and the delivery model as challenging. Case I exhibited the co-existence of logics, as a common project logic failed to develop, and the actors behaved as in a traditional project.

20 interviews were conducted with respondents from the three main organisations as well as separate hierarchical levels, two days of observation and document analysis.

In case I, the initial setup, where contractor and design engineer worked together during procurement, led to a dyadic relationship between them, excluding the client. Resource needs were related to the contract and risk allocation therein, as well as changes and unforeseen events during project delivery. Although the project space was co-located between client and contractor, the design engineer did not fully attend it and the division of the space according to home organisation meant a lack of social interaction between the organisations. The actors moreover had a traditional view of both project and each other's roles, identifying with their home organisations over the project and questioning the novelty of the collaborative approach. Even though the network was high in transitivity (0,3913043), its density (0,03717949) and average path length (2,565217) were lower than for the other cases. Its clustering was moreover high (0,5300706) due to the high centrality of the design team. This, analysed in combination with the interviews and observations, indicate a bridging network. As the network was very fragmented, no clear central actor appeared except for the design team representatives. These actors had the highest values on degree, betweenness and closeness. Due to the disjointed nature of the network, eigenvector values did not offer insight. Figure 3 shows the project network.

The project was a megaproject in its context due to its size, the long-term nature of the process, complexity, the number of organizational interfaces of the process and societal impact.

The case has been called Bilateral, Rail, Station, Train and CentralRail in the appended papers.

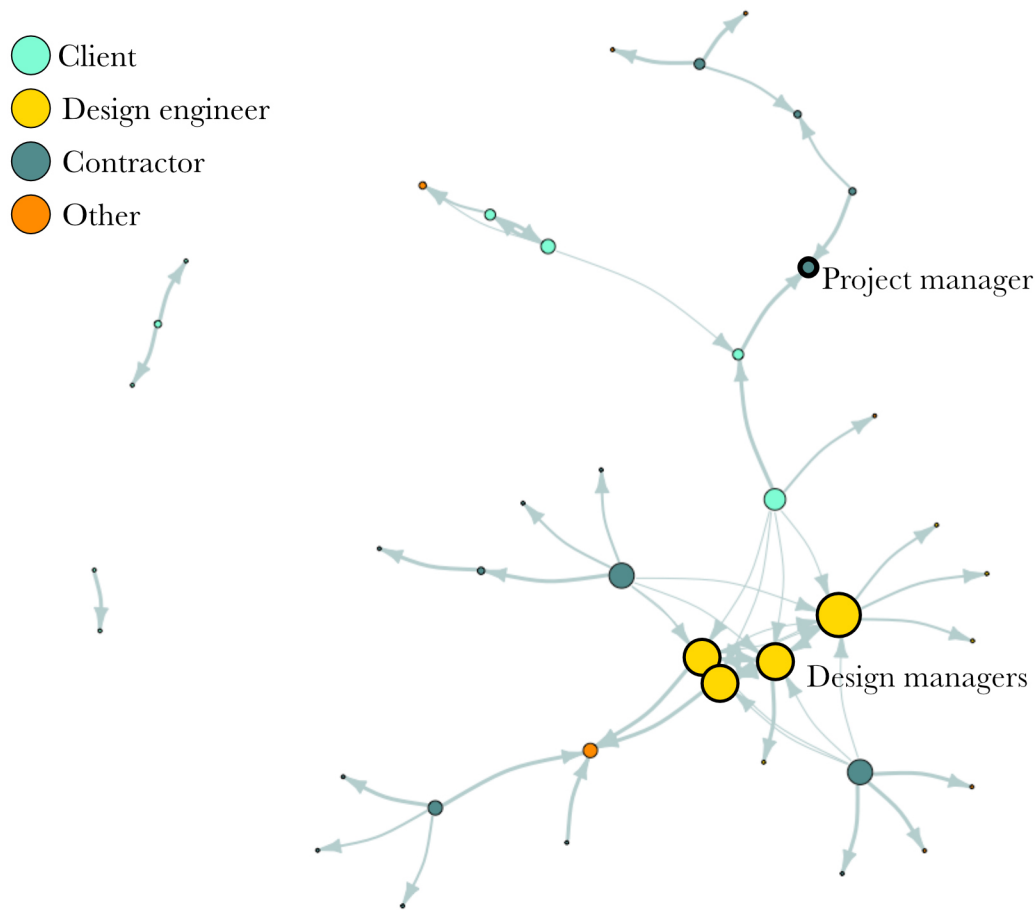


Figure 3: Project network in case I

5.6.3 Case study II

Case study II focused on a megaproject in one of the five largest Nordic cities, building new public transportation infrastructure in a major metropolitan hub which crosses city lines. The project used alliancing as their CPDM model, with the main actors (two municipalities, two construction companies and two design engineering firms) all entering the same multi-party contract. Due to organisational rearrangements as one of the companies has exchanged owners during the project duration, the contract parties have partly changed throughout the project but the personnel is mainly the same.

The project started in 2016 with project development and procurement, followed by phase 1, planning and design, in 2017 and phase 2, detailed design and construction, in 2019. The client expects the project to be delivered in 2024. The monetary value of the project is approximately 390 million euro, or approximately 4,23 billion SEK.

The main actors are all part of the same project organisation, although the project site was divided into seven blocks between the two design engineering firms in phase 1, as well as into five blocks between the two construction companies in phase 2. The project used a common document platform and a main project office as well as block offices, with seating for both the three main actors, as well as ‘floating desks’ for occasional guests. During phase 1, all actors were seated at a central project office, with seating allocated according to their role in the project. During phase 2, clients, contractors and design engineers moved partly out to offices at the construction site, although the central project management team remained at the office. The project was perceived

as a single project with clear goals and division of responsibilities. The project was moreover viewed as novel and exiting and the delivery model as positive.

24 interviews were conducted with respondents from the six main organisations as well as separate hierarchical levels, five days of observation and document analysis.

In case II, the initial procurement of first choosing a design engineer and then a contractor led to an initial dyadic relationship between client and design engineer. The multi-party agreement enabled them to include the contractor in the project organisation latter on. Case II exhibited dominant logics between both the two main contractor organisations and the two client organisations. In both cases, the dominance was felt to depend on the size and power of the larger organisation. The contractor organisations adapted tools and processes from the larger organisation, which was explained as sound practice by a project manager from the (larger) contractor and a saving on resources as the project 'did not have to invent the wheel again' (project manager). However, the smaller organisation felt overruled and like they had to adjust. Between the client organisations, the conflict for dominance was also rooted in differences between power and size as well as past political conflicts and infrastructure projects gone bad. Here, the smaller organisation used their political power to re-iterate the home organisations' commitment to the project. On an individual level, representatives from both smaller organisations were dissatisfied with the perceived power play of the larger, formally more dominant organisation, which in turn affected the collaboration within the project network.

Resources were shared as needed, both in terms of expertise and time spent at the project, although the commercial model incentivised the project organisation to use hours from the contractor over hours from the design engineer, leading to a few individuals changing employers to stay in the project. The co-location of the project office and division according to role in the project enabled frequent interaction between all actors and the creation of informal social exchanges, such as coffee breaks and sports groups. The novelty of the project and CPDM used, as well as a common wish for a continued use of the model in future work, emerged as a shared theme. The actors identified with the project and viewed it as interesting and a learning opportunity. The network was lower than case I in transitivity (0,1421801), although higher in density (0,04207317) and average path length (5,367347), while its clustering was low (0,2373486). This, in combination with the interviews and observations indicate a cohesive network. Key actors differed in their network power. The project manager and a block chief had the highest degree, as well as the highest value in closeness. In addition to the project manager who had the highest betweenness value (or the power of their broker position), a design manager rose to a key role on this metric. When looking at eigenvector scores in the cohesive network, or the number of influential actors a specific actor is connected to, the project manager was still the main network actor, but in this aspect the client representatives also became prominent, with scores over 0,5, as did the client's communications specialist, who had the second highest score after the project manager. These diverging measures indicate a somewhat unbalanced network with diverse actors and paths. This might also be a result of the organisational changes that took place recently before the data collection. The project manager's prominent position in all indicates their importance in the network. Figure 4 shows the project network.

The project was a megaproject in its context due to its size, the long-term nature of the process, complexity, the number of organizational interfaces of the process and societal impact.

The case has been called Multiparty, Tram, Speed and LightRail in the appended papers.

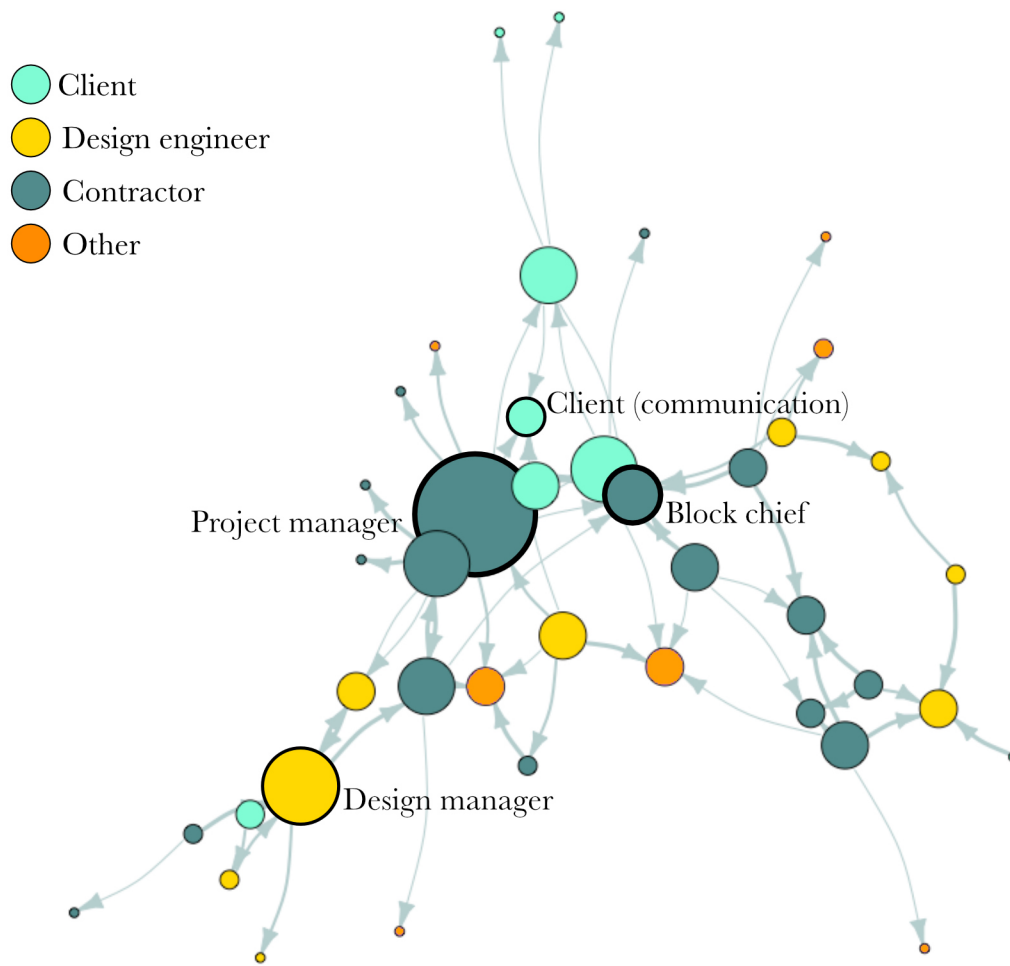


Figure 4: Project network in case II

5.6.4 Case study III

Case study III focused on a major project in one of the five largest Nordic cities. The project's goal is to renovate an immersed river tunnel. The project's governance consists of four main sub-projects: preliminary design, construction works (design-build with a high degree of collaboration), traffic and civil works (design-build with a degree of collaboration) and technical installations (design-build). The project does not have a stated CPDM approach, but has worked with an explicitly stated collaborative mindset from the beginning.

The project started in 2019 with project development and procurement, followed by phase 1, planning and design, in 2021 and phase 2, detailed design and construction, in 2022. The client expects the project to be delivered in 2023. The monetary value of the project is approximately 39,6 million euro, or 430 million SEK, divided into the three sub-projects as follows: construction works (230 million SEK), traffic and civil works (100 million SEK) and technical installations (80 million SEK).

Although the project was governed by several separate contracts, the client strived to organise the project leadership as one main leadership team. The project was organised as a main client organisation and separate sub-project organisations with respective contractor, who were all seated at the same project office during phase 1. The main actors –client and contractor(s)– strived to mirror each other's project organisations. However, due to the Covid-19 pandemic, the project was initiated and much of phase 1 was conducted virtually through video meetings

and common digital platforms. Actors did join the co-located space physically at the end of phase 1. During phase 2, the contractors moved out to offices at the construction site although the client stayed at the project office and meetings were still held there. The project used a common document platform and a main project office as well as block offices, with seating for both client and contractor, as well as ‘floating desks’ for occasional guests. The project was perceived as a single project with clear sub-divisions and common goals and division of responsibilities. The project was moreover viewed as novel and exiting and the delivery model as positive.

16 interviews were conducted with respondents from the five main organisations as well as separate hierarchical levels, two days of observation and document analysis. The case study will continue as a longitudinal case study after the current research project is completed.

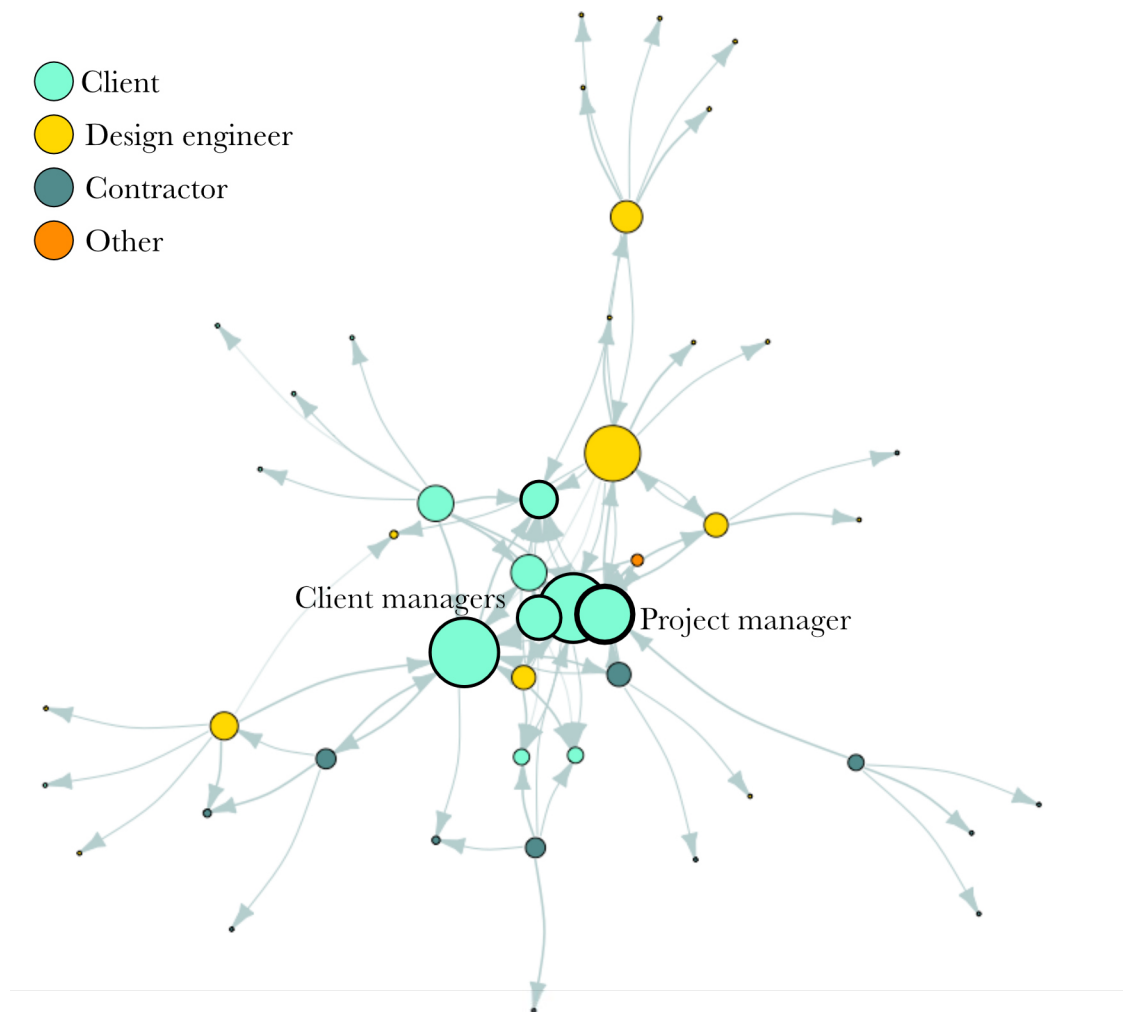


Figure 5: Project network in case III

In case III, the project organisation was created according to the governance structure. However, the strong focus on collaborative practices and client attitude towards collaboration enabled trust and a shared understanding of the project. Resources were shared as needed and although the sub-projects belonged to separate contracts, strong social ties enabled informal discussions and best-for-project decisions. Although the project office was divided according to home organisation, social interactions, such as common coffee breaks or ping-pong games during down-time, were frequent. The actors identified partly with the project and partly with their home organisation but did view the project as having a strong collaborative culture. In case III, although

the project was divided into three sub-projects and there was a certain degree of co-existing logics within the sub-projects, a common project logic emerged on the leadership level as actors shared resources, knowledge and information freely. The network was cohesive, although the sub-projects were visible in the structure. The network was higher than case II but lower than case I in transitivity (0,384), higher than both in density (0,0439408) and average path length (6,883549). Its clustering was low (0,1457177). This, in combination with interviews indicated the most cohesive network of the studied cases. Key actors in the network were the client's sub-project managers, followed by the project manager based on degree and eigenvector centrality. Based on client's sub-project managers and the design manager was also a key broker according to betweenness and closeness. Surprisingly, although the project manager's degree and eigenvector centrality were high, they did not occupy a broker role in the network, indicating a cohesive network around them, where the sub-project managers occupied gatekeeper positions with respect to their sub-projects. These measures imply a balanced network where actors' influence is quite equal. Figure 5 shows the project network.

The project was a megaproject in its context due to its the complexity of the process, the number of organizational interfaces and the project's societal impact.

The case has been called Tunnel in the appended papers.

5.6.5 Case study IV

Case study IV focused on a sub-project of a railway construction programme in the United Kingdom. The sub-project itself is classed as a megaproject and its goal is to construct 24,7 km of railway, partly in central London. The project's governance consists of a joint venture between three construction companies who have subcontracted design engineering through another joint venture. The project is further divided into the approximately equal-sized three geographically delineated sub-projects. Although the project lacks a formalised CPDM contract, the client has started the programme with an explicitly stated collaborative mindset and included collaboration in the project design. The studied project was thus governed by a bilateral contract between the client organisation and a joint venture consisting of contractor companies. The contract was similar to the other contracts in the larger rail programme between the client and other joint ventures.

The project officially started in 2009 with legislation enabling the foundation of the client organisation and governance structures within national government. For the sub-project, project development and procurement started in 2013. Phase 1, planning and design, ran from 2014 to 2020 and phase 2, detailed design and construction, started with a notice to proceed in 2020. The client expects the project to be delivered in 2023. The monetary value of the project is approximately 5,77 billion euro, or 62,9 billion SEK or five billion British pounds.

The client and contractor(s) interacted frequently. During phase 1, all actors were seated at a central project office, with seating allocated according to their role in the project. During phase 2, contractors and design engineers moved partly out to offices at the construction site, although the project management team remained at the central office. During phase 1 the collaboration between contractor and design engineer was rated high, but since construction began, the interaction with the design engineer has lessened and fallen into more traditional patterns. The project used a common document platform and a main project office as well as sub-project and block offices, with seating for the main project organisation, as well as 'floating desks' for occasional guests. The project was perceived as a single project with clear sub-divisions and common goals and division of responsibilities. The project was moreover viewed as novel and exiting and the delivery model as positive. In case IV, the shared project logic and identity was expressed through a continuous reiteration of common project values, goals and efforts to promote social ties and network formation.

17 interviews were conducted with respondents from the three main organisations as well as separate hierarchical levels, with a focus on the leadership team, and document analysis. The project offices were observed during a week-long study visit.

The project was a megaproject in its context due to its size, the long-term nature of the process, complexity, the number of organizational interfaces of the process and societal impact.

The case has been called Shaft in the appended papers.

5.6.6 Summary of case findings

As CPDM can be defined as formalized relational approaches (Chen et al., 2018; Lahdenperä, 2012), the majority of project participants in a CPDM are as yet stepping into a new environment. Although this will change as CPDMs become more ubiquitous, the formal framework emphasizing the relational aspects of the project is still new and requires adaptation from the actors. As the research has followed an abductive approach, Table 8 summarises the papers with respect to the separate case studies for easier overview.

Collaboration and the project network relate to, first, the degree of collaboration in the project and second, the project network as understood from the interviews. As case IV focused on the leadership team, the project network was not mapped out in this study.

Role behaviour depicts the organisational actors' behaviour within the project organisation.

Expectations of other actors focuses on the actors' expectations of each other.

Project identification and perception describes the level of common identification people showed with the project organisation exhibited in the studies, as well as the perception of the project's novelty and development.

CPDM continuation relates to the impact the project has had with respect to the continued use of collaborative models.

Table 8: Summary of project organisation and project network

	<i>Case study I</i>	<i>Case study II</i>	<i>Case study III</i>	<i>Case study IV</i>
<i>Collaboration and project network</i>	<ul style="list-style-type: none"> • Relatively close collaboration contractor and design engineers • No joint social events between all three actors. • Bridging and disjointed network 	<ul style="list-style-type: none"> • Good collaboration initially between client and design engineer. Over time good collaboration with all actors • Joint social events, after work, celebrations etc. • Cohesive network 	<ul style="list-style-type: none"> • Good collaboration initially between all key actors. • Joint social events, after work, celebrations etc. • Cohesive network 	<ul style="list-style-type: none"> • Good collaboration initially between all key actors. • Joint social events, after work, celebrations etc. • N/A re. project network
<i>Role behaviour</i>	<ul style="list-style-type: none"> • Client less engaged in project, remains traditional client role • Contractor falls back in traditional role, awaits requirements from client • Design engineer subcontracted by contractor, no communication with client in design. 	<ul style="list-style-type: none"> • Client present in project office, engaged, enabling joint decision making and ease of communication • Contractor inexperienced in leading design. Challenges for existing revenue and profit generation. • Design engineer had to adapt to working in one project. Difficulties with collaborating with contractor (different views). 	<ul style="list-style-type: none"> • Client present in project office, engaged, enabling joint decision making and ease of communication • Contractor unexperienced in leading design. Challenges for existing revenue and profit generation. • Design engineer not overly engaged in delivery stage. 	<ul style="list-style-type: none"> • Client present in project office, engaged, enabling joint decision making and ease of communication • Contractor unexperienced in leading design. Challenges for existing revenue and profit generation. • Design engineer not overly engaged in delivery stage.
<i>Expectations of other actors</i>	<ul style="list-style-type: none"> • Client expected contractor to be more engaged in whole process. Design quality responsibility of contractor • Contractor: feels that the design quality responsibility is for the client • Design engineer: N/A 	<ul style="list-style-type: none"> • All actors perceived the client role as changed the most. • Contractor and design engineer still view each other as the traditional role and discussions on delivery of work and timing of deliveries are relevant 	<ul style="list-style-type: none"> • All actors perceived a role change to be necessary. • Design engineer not discussed in terms of role change 	<ul style="list-style-type: none"> • All actors perceived the client role as changed the most. • Contractor and design engineer still view each other as the traditional role and discussions on delivery of work and timing of deliveries are relevant
<i>Project identification and perception</i>	<ul style="list-style-type: none"> • No single project identity. Diverse understandings of the delivery model and responsibilities of actors • Project perceived as traditional - design-build. Roles are not perceived as changed 	<ul style="list-style-type: none"> • Perceived as a single project identity with clear responsibilities. Delivery model seen as positive • Project perceived as new, and indented to change the traditional way of working. Project continuously worked on developing the model and collaboration. 	<ul style="list-style-type: none"> • Perceived as a single project identity with clear responsibilities. Delivery model seen as positive • Project perceived as new, and indented to change the traditional way of working. Project continuously worked on developing the model and collaboration. 	<ul style="list-style-type: none"> • Perceived as a single project identity with clear responsibilities. Delivery model seen as positive • Project perceived as new, and indented to change the traditional way of working. Project continuously worked on developing the model and collaboration.
<i>CPDM continuation</i>	The public client has changed the CPDM for future projects	The public client has applied the same CPDM for future projects	Interested in continuing with the model, no decision made yet	Interested in continuing with the model; expresses uncertainty of possibility to do so due to political pressure

6 DISCUSSION

This chapter contextualises the discussion on the research findings as presented in the appended papers, structured according to the research questions presented in section 1.3, Research questions.

6.1 Social network theory, relational governance and CPDM

6.1.1 The interplay of relational governance and (in)formal ties

Although it is the characteristics of the nodes that give the meaning of the social relations (Friedland and Alford, 1991; Granovetter, 1985; Scott, 2013), I will not dwell overly long on their importance. For example the importance of their social capital (Burt, 2001) or the outcomes of actor interaction (Loosemore et al., 2020) is well known. I follow the stream of recent research and focus on formal and informal ties (Adami and Verschoore, 2018; Papadonikolaki et al., 2017; Wang et al., 2018) through a multi-level view of the project network based on these relations.

Different ties influence the project at different stages of the project process, as paper I demonstrates. During the starting phase, formal ties such as contracts and the roles allocated by home organisations, create the basis for interaction within the project. As everyday interactions take place in the project office, however, the opportunity for informal ties to form arises. In a well-functioning CPDM, this combination then leads to a unified project identity and understanding of project goals is then built together as a cohesive project network forms.

Four aspects were identified as influencing network formation: (1) the initial setup and project identification; (2) resource sharing; (3) a co-located project space; and (4) expectations of other actors' (Paper I). These aspects are a combination of formal and informal ties. The initial project set-up is based on the procurement stage, contract and collaborative agreement, as is the methods for resource sharing and the configuration of the co-located space. How they develop and are utilised, however, depends on the informal ties created within the project. Project set-up and organisation does give the framework for project processes, but the social dynamics within the project network determines if communication flows freely throughout the project or if it is constrained to formal meetings. The one exception is the fourth aspect, expectation, which is based on actors' experiences and their institutional framing. It can therefore be defined as an actor characteristic.

Formal ties, such as contracts, are thus important in defining the project (Bygballe et al., 2015; Papadonikolaki et al., 2017) but their influence wanes as social interaction and informal ties compounds. Knowledge-sharing (Nell and Andersson, 2012) is eased through the cohesive network created in a project building on a mutual understanding of the formal ties (Paper I). A mutually understood formal tie, supported by informal ties, is accepted by project actors both in letter and spirit, enabling direct communication, while a nominally accepted formal tie can hinder the creation of informal ties and thus becomes a barrier to the formation of a common understanding of the project (Paper I).

The formal ties are also mainly decided on an organisational level as it is the parent organisations that enter into a contract regarding the project. Individual project participants have therefore little power over this formal, regulative dimension, unless they happen to be the corporate lawyers involved. Formal ties decide which actor roles exist in the project, the structure of the organisation and how decisions are made and so shape the framework for the informal ties creating the project network. Although individual actors thus have little power over the formal ties shaping the project as it is ongoing, but have great power in influencing the development of standardised contracts and framework on a field level.

Informal ties thus rely on the formal ties and the framework created thereby. For example, exclusion from project-wide social activities due to internal policies, as happened in case I, can hinder the formation of ties and promote in-group formation within the project, leading to a bridging network rather than the sought-after cohesive one. Spontaneous social interactions, as exhibited in case II, lie on the other end of the spectrum, where the organisation-level commitment to and common understanding of the project enabled a collective culture to emerge between the key individuals attending the project office. There were, however, mentions of difficulties in crossing organisational and professional boundaries in all cases: “it’s easiest to for a designer to get along with another designer, rather than a contractor,” as a design engineer manager in case II said.

Successful relational governance builds on the informal ties, such as sharing of resources (Galvin et al., 2021; Lahdenperä, 2012; Pinheiro et al., 2016; Walker and Lloyd-Walker, 2015) and trust (Kadefors, 2004), which in turn require a strong, positive tie to other actors (Pinheiro et al., 2016). The contract and formal project design may support this by defining common platforms and sharing processes (Hietajärvi and Aaltonen, 2018) but without the will, there is no way for the need for resources to become known to the greater network. For example, an informal discussion regarding site offices and first an informal agreement which turned formal through the project process was made in case III: the project schedule enabled one sub-project to use the site offices first for their part of the project, and another sub-project to take over their management afterwards, when their part was scheduled to start.

The formal ties create the framework for the project organisation and process. Informal ties ease the flow of information and the building of trust but require time and space to grow. Although the networks shown in figures 3,4 and 5 are ‘snapshots in time’, the network in case II and III developed over time with the support of strong informal ties and the right attitude. The network is initially based on the formal framework created by the contract but then evolves as the project matures, supported (or hindered) by the informal ties. When a network is bridging and siloed, as in case I, the information flow reduces and hinders trust-building between different groups. The impact of informal ties on the project network could also be seen in how co-location exhibited at the different cases. In case I, the space was divided according to organisation, while case II and IV designated it according to project role and geographical allocation. The informal ties within the geographical and role-based groups were much stronger in case II and IV, while case I became fragmented along organisational lines due to a lack of social interaction.

A surprising finding was how the hybrid model of virtual and physical co-located project offices exhibited in case III due to the Covid-19 pandemic. According to literature, this should have been detrimental or at least created a collaboration barrier (Kokkonen and Vaagaasar, 2018; Lahdenperä, 2012; Walker and Lloyd-Walker, 2015), but these fears failed to manifest. This was attributed to the project manager who managed to create a collaborative culture which led to strong informal ties. Likewise, the strong informal ties in case II helped them transition into Covid-19 and deliver the project before schedule and under budget. The potentially detrimental impact of formal ties, such as inflexible project processes, or practical problems, such as suddenly dispersed working spaces, can therefore be mitigated by strong informal ties and conscious relational governance.

The shape of the project organisation in a CPDM depends on how the formalised relational approach is set up and how the project is formally governed (Paper V): differences in the adoption of CPDM led to differing organisations and views of both project and delivery. Respondents in all cases for example remarked on the necessity of suitable characteristics of project actors and that “not all [people] can even be expected to collaborate” (project manager, case III). This is in line with earlier research on collaborative capabilities and skills required for the successful implementation of CPDM (Hietajärvi and Aaltonen, 2018; Walker and Lloyd-

Walker, 2015). Where there is a will, there is a way, and the creation of strong project networks in case II and III supports the notion of the right attitude required for collaboration to occur and the CPDM to be implemented successfully, rather than merely a reliance on contractual clauses: in case II, all main actors were gathered under the same multi-party contract, while case III was governed by three different contracts. The common denominator is the participant's attitude and efforts put into collaboration. The path from formal collaborative contract to successful informal relational governance is thus not as clear-cut as previously thought.

The introduction of –or return to, as some would argue– relational governance in megaprojects introduces change to the industry as we know it today. The relational approach used to alleviate the inherent uncertainty of megaprojects (Biesenthal et al., 2018; Flyvbjerg, 2014) necessitates a higher reliance on relational ties, such as social interaction and co-location, rather than formal ties (Papadonikolaki et al., 2017), such as contract and project organisation design (Paper I). The social network perspective gives a different perspective on the project organisation than traditional approaches, such as transaction cost or agency theory, which focus on the organisational level.

My study supports earlier research on how network structure influences information dispersal and the acceptance of different types of change (Battilana and Casciaro, 2012): a cohesive network with numerous social ties helps shift the focus from traditional processes and roles towards new behaviours and practices (Paper II) through information flow and building trust (Paper I). Thus, although a cohesive network with strong social ties can enable information flow and incremental change and a bridging network hinders flows within the network (Battilana and Casciaro, 2012; Paper I), the network structure is relevant at different project stages. As the CPDM introduces novelty and megaprojects introduce change by their existence, initial acceptance may be easier to achieve through a dispersed network. A bridging network is beneficial for divergent change (Battilana and Casciaro, 2012), which might be required when first introducing for example a novel project management model such as the CPDM. When the project is instituted and setup begins, however, a cohesive network helps with information flow within the project which helps in trust-building, key for the success of CPDM. Cohesive networks ease the adoption of new formal ties, such as new project organisation structures or roles as required by CPDM, while the lack of social relations in the bridging network lead to a retreat to familiar and traditional project practices (Paper I; Paper V). My research thus contributes to a deeper understanding of the multi-level interaction of formal and informal ties in shaping the project network, as well as the processual shift from formal to informal ties as the project progresses. Social network dynamics are important in creating a project network that supports the implementation and successful delivery of CPDM-based projects.

6.1.2 The weakness of strong ties

CPDMs build on strong relational governance and strong ties have consequently been viewed as beneficial (Lahdenperä, 2012; Poppo and Zenger, 2002; Walker and Lloyd-Walker, 2015). When discussing the weakness of ties, the focus is often on network structure and how this affects network actors rather than the ties themselves (Burt, 2001; Granovetter, 1973; Zeng et al., 2022). However, strong ties are shown to reduce innovation and diversity (Wang, 2016) as similar actors have an easier time forming connections (McPherson et al., 2001), so decreasing the introduction of new resources into the network. This is especially important in megaprojects, where the project's long-term character by design forces network changes as individuals join and move on from the project. Two main challenges emerged during my research: network structure and tie formation.

As mentioned, a cohesive network enables trust-building and rapid information exchange (Battilana and Casciaro, 2012). As discussed in paper III, however, new actors may have

difficulties in entering the project network if the initial ties are too strong. In case I, the strong social ties between contractor and design engineer, created during the tendering phase, acted as a barrier for the client's entry when the project proper started. In case II, the eagerness of client and design engineer to start with the project became a barrier for the contractor to enter the network. The strong collaborative culture created within the project managed to overcome this initial set-back. Yet the same strong culture became a barrier to the whole project network, as those outside the in-group formed within the project lacked pertinent information about the project, such as processes and practices at the co-located office, as well as informal norms and rules related to the project culture.

Moreover, a shared understanding occurs most readily when the individuals share a frame of reference (McPherson et al., 2001) although the tie between them also helps interpret the social interaction between two individuals (Powell and Oberg, 2018). The social creation of relationship meaning might lead to divergent understandings of the tie for the involved individuals (Powell and Oberg, 2018; Scott, 2013) and the type of tie is thus dependent on the understanding of the tie, although a shared understanding is more likely when the involved individuals share an institutional framework (McPherson et al., 2001; Powell and Oberg, 2018). There might therefore be a need to discuss how 'collaboration' is used in relation to CPDM, as the joint sharing of resources, responsibilities and project success implicated by the model might not be optimal for all project phases, or all project participants. In contrast to the consensus regarding the definition of 'collaboration', project practices and behaviours differed. There is therefore a need to define collaboration further and look at how it is applied in the CPDM context.

Since CPDM builds on trust and mutual understanding, social relations are paramount in creating a successful project with this model. Strong social ties do confer benefits to projects, such as rapid information sharing and trust building (Paper I). However, strong social relations can also hinder the entry of new actors into the network. In long-term projects, such as infrastructure delivery, a certain degree of actor change will happen due to personnel changes and organisational changes. When strong ties form in a project network, it thus becomes difficult for new actors to enter the network, both individual and organisational, constricting network exchange and renewal (Paper III).

My research contributes to a deeper understanding of the character of network ties and connects the discussion on benefits of CPDM to the research on network dynamics and the challenges of overly connected networks. Although CPDM relies on strong ties and cohesive networks, this perspective does not take the project's longevity into account. This aspect necessitates further research, as megaprojects are long-term endeavours and the project network changes as project actors change.

6.2 CPDM: A changing context and the impact on institutions

As the project organisation and structure changes with the introduction of a CPDM (Lahdenperä, 2012; Walker and Lloyd-Walker, 2015), so do project processes, roles, actors and behaviours (Paper II, Paper IV). I will start with discussing the multi-level view, whereafter I turn to the changing process, and finally to roles and actors.

6.2.1 A multi-level view of the network

The multi-level view taken in this work enables a deeper understanding of the interaction necessary for project delivery: projects exist in interaction between the organisations contractually bound to them and the individuals assigned to the projects to fulfil the activities necessary for a successful project, and the interaction between the project and its environment creates a complex inter-organisational setting. Using relational governance and CPDM in infrastructure delivery,

based on social interaction and informal ties, emphasises the multitude of perspectives, expectations and assumptions inherent in the project (Steen et al., 2018).

Organisation: The project network in a CPDM is created by interaction within the project (Adami and Verschoore, 2018; Hellgren and Stjernberg, 1995; Pryke, 2012), both on an individual but also organisational level. The configuration of social ties and network structure can help explain the change process introduced by using a CPDM, as traditional social ties are rephrased and reworked. The organisational characteristics, such as institutional background and role in the project (client, contractor or design engineer) shapes their approach to the formal ties, as for example opinions on the correct incentives to use or best practices may differ between these.

Project: The project norms changed as the formal ties changed, introducing new processes, roles and behaviours. These formal ties thus shaped the informal social understanding inherent in the norms accepted in the project. This is enacted by the individuals but is shielded from affecting the parent organisations through the separated project organisation. The parent organisation can thus consciously and directly change the project and its norms by formal ties, while the informal ties take the scenic route and affect the *next* project the parent organisation participates in.

Individual: Project procurement aligns the interests and expectations of participating organisations (Eriksson et al., 2019; Hietajärvi et al., 2017), formally through the contract. However, the interpretation of said interests and expectations is realised through individuals participating in the project and are thus also mediated by the individual's own interests and expectations and cultural-cognitive understanding. There is furthermore a need to develop a clear understanding of responsibilities within the project organisation, as relational contracting necessitates a cohesive view of the project and its goals (Paper IV). Thus, for a common view and relationships to form, a unified project identity becomes important (ibid.). This enables a common project goal and understanding of the project (Paper I). For example, in case II and IV, respondents mentioned a feeling of relief as the CPDM enabled them to focus on problem solving rather than contractual aspects, while all respondents in case I focused on the contract. There was thus a misalignment of expectations in the initial project phases in case I, while case II and IV managed to align expectations on both a project and individual level. Thus, aligned expectations can be seen as a manifestation of trust and strong ties, which indicates the emergence of effective relational governance.

My research point to the importance of taking the different project levels into account, as the network dynamics are both created in the interaction between these, and the formal and informal ties affect these in different ways. A successfully implemented CPDM, relying on social ties, is thus the result of both a top-down but also a bottom-up collective effort.

6.2.2 Process change

The project process changes in a fundamental way as project governance move towards relational governance instead of the traditional reliance on contractual governance. The introduction of relational contracts requires new skills from both project planners and actors as they navigate their changing environment (Paper IV). This was especially visible when contrasting case study I and II and explored in paper V: in the project with a more contract-based governance during the whole process, the actors reverted back to traditional arm's length roles, while in the project that managed to pivot to delivery based on relational governance, the actors managed to find new ways of working and change their approach to the project.

The project process changes the most in phase one, design and project planning, due to the early inclusion of all key actors required by CPDM (Chen et al., 2018; Eriksson, 2010; Lahdenperä, 2012; Walker and Lloyd-Walker, 2015) and the project must consequently be planned with the early inclusion of key actors in mind to accommodate a period of adjustment and aligning of differing institutional perspectives (Biesenthal et al., 2018; Matinheikki et al., 2019). See Figure

2 in chapter 2 for a visual representation. Phase two, delivery, faces changes due to concurrent design work and delivery planning, which introduces iterative aspects to the formerly linear delivery phase (Paper II, Paper V). The project pre-phase, including procurement, is out of scope for this research.

However, as key actors participate in phase 1, design and project planning, the traditional project process changes from a linear design-bid-build model towards an iterative process where design and construction partly overlap (Paper IV). In phase 2, the process took on more traditional characteristics although the overlap between design and construction did lead to tension, especially in case II (Paper I, Paper III).

Since the *client* chooses both procurement and project model, their influence in early stages follows convention (Denicol et al., 2021; Kedefors, 1995). The client is actively engaged during the whole process, as opposed to their traditional arm's length approach and intermittent contact with the project. The design engineers must adjust to working with differing expectations and practices, as opposed to their former focus on pure design work. The contractors have to accept the unfamiliar uncertainties of working in the iterative early phase, as well as the constantly changing project that comes along with it (Paper II, Paper IV).

In the cases with a well-functioning CPDM, *the client's process* changed from distant supervision to active participation. Moreover, when the client is actively engaged in the project organisation with enough decision-making mandate, as prescribed by literature (Lahdenperä, 2012; Walker and Lloyd-Walker, 2015), knowledge and information sharing became quicker, building trust and a mutual understanding of the project (Paper I, Paper II). However, this could lead to tensions with their home organisation as exemplified by the two client organisations in case II who had different mandates for their work in the project: the other actors viewed the one with greater mandate as a more flexible and agreeable partner.

The biggest changes in *the design engineer's process* were due to the inclusion of other key actors in phase 1. They were used to working with the client in iterative early project phases, but tensions between design engineer and contractor were visible both in case II and IV, the two projects with the greatest interaction between these actors (Paper IV). Perceived changes in the design engineer's process may however have been due to local institutional context rather than inherent traits in the role: case II was the only one to mention the challenges of committing full-time to the project, as the local context required experience from multiple projects from the last years for the design engineer to be successful. This shaped how the home organisation fulfilled their obligations regarding personnel as well as the individual's choices regarding their participation in the project.

As a CPDM requires early contractor involvement (Chen et al., 2018; Walker and Lloyd-Walker, 2015) and the contractor is accustomed to working with accepted designs (Hughes and Murdoch, 2003; Löwstedt and Räisänen, 2014), *the contractor's process* faced major changes. This need was identified by contractor leadership, although lower management levels held quite traditional views of the other actors (Paper II).

Combined, these process changes, especially in phase 1, lead to major changes in role and behaviour. As institutions convey stability and common norms and behavioural rules, the aforementioned changes lead to institutional conflict and tension.

6.2.3 Changes in roles and behaviours

CPDM presupposes new roles, such as collaboration coordinator (Walker and Lloyd-Walker, 2015). Moreover, CPDM requires the best suited person, not people based on their role in their home organisation. For individuals in a CPDM, the relational approach thus emphasises their

role in the project rather than in their home organisation (Paper IV). These aspects, combined with the process changes described above, lead to new role requirements and behaviours.

Project management can be divided into internal and external management. Internal management refers to the day-to-day activities taking place within the project, exemplified by the project manager, while external management concerns the participating organisations' formal connections, such as project sponsors or promoters (Paper II, Paper IV). The internal project management needs to adjust traditional roles and skillsets due to the interorganisational interactions in a CPDM as well as enable organisational collaboration due to the early involvement employing a CPDM demands (Paper I, Paper II). The external project management's traditional focus on arm's length relationships is changing towards a more involved management style, partly due to the collaborative process introduced by the CPDM exemplified by the focus on united decision-making in project alliances (Hietajärvi et al., 2017; Matinheikki et al., 2019; Walker and Lloyd-Walker, 2015).

Administration enables the day-to-day running of the project, while *dispute resolution* procedures, a feature required by CPDM (Lahdenperä, 2012; Walker and Lloyd-Walker, 2015) ensures security for participants when facing challenges, an inevitability of infrastructure projects, and supports the creation of a unified project identity (Paper II, Paper IV). Administrative roles are for example the project administrator or assistant, contract administration and financial planners. Due to the increased variety of skillsets and collaborative skills required by CPDM, individuals involved in administration and dispute resolution from different organisations must work together to ensure the continuous presence of all necessary skillsets within the project and that the formal frameworks are adhered to (Paper II).

Although *design work* mainly occurs in phase one, the design engineer still plays a supporting role in phase two. Design work concentrates on delivering designs related to the project (Hughes and Murdoch, 2003), such as bridge designs, tunnel sections or railway dimensions. The work is iterative as the designer searches for the optimal solution, receiving input from projections and estimates as well as new information uncovered when construction work begins. Examples of designers are civil engineers, acoustic specialists and landscape architects. In a CPDM, they must be comfortable with working in a co-located project office as opposed to their home organisation offices, in tight collaboration with contractors.

Construction work takes place mainly in phase two, but due to the inclusion of early contractor involvement in phase one (Lahdenperä, 2012; Walker and Lloyd-Walker, 2015), they have to adjust their way of working to accommodate this change. Construction is responsible for the execution of the planned construction activities, as defined by the design and project plan. The work process is mainly linear, starting in accepted designs and ending in a physical object. Examples of individuals in construction include trade contractors and artists hired to beautify a train station (Hughes and Murdoch, 2003). The introduction of CPDM requires contractors to be involved in earlier, iterative phases of the project, as well as work together with designers on developing the design from the start (Paper IV).

Regulatory oversight may be connected to the client organisation, but can also be a separate governmental entity (Denicol et al., 2021; Hughes and Murdoch, 2003). They are involved in the project due to regulatory or legislative reasons, such as supervising environmental stipulations placed on the project. Statutory authorities, local council authorities and planning bodies exemplify this role. In a CPDM, the regulatory actors must be comfortable with a certain degree of autonomy and uncertainty in the project. However, the mandate of client representatives at the project must also be defined and the responsibilities between project and home organisation should be clear (Paper II, Paper IV).

As the project model and process is based on sharing, openness and trust (Lahdenperä, 2012; Schepker et al., 2014; Walker and Lloyd-Walker, 2015), individual characteristics and behaviour become accentuated. The changes in contact with their home organisation and physical working arrangements, for example, influence the client and design engineer, while the contractor needs to adapt to iterative early-stage work.

The client's role behaviour changes from distant, supervision-focused control to active project participation (Paper II, Paper IV). However, due to institutional forces in their home organisation, they might not be able to take on the role a CPDM specifies as regulations and national legislation and frameworks may hinder the delegation of power required. Client representatives, used to keeping an arm's length relationship to the project, are required to become engaged in the project organisation and facilitate interaction with their home organisation. This requires new behaviours and processes, both at their home organisation, but also on a personal level, as they balance between the demands of the project and their home organisation.

The *client organisation* must delegate a certain amount of decision-making power to their representatives in the project organisation, as well as assign individuals to an extended stay in the project, which entails change on an institutional level (Morris and Geraldi, 2011). They must moreover accept a certain amount of risk, as the model allocates risk to the ones most suitable to bear it (the client), rather than externalising it through the contract (Paper V). This change from the traditional arm's length relationship can lead to further conflict if this change is not managed properly, as seen for example in case I, where co-location was instituted through project design, the client and contractor failed to achieve collaboration as they had divided the space between themselves rather than sharing it.

The design engineer's role behaviour changes are mainly dependent on the interaction of the other two actors. Although a CPDM necessitates a high level of involvement, the design engineer is mainly engaged in phase 1. However, they do need to adapt to informal interactions with both client and contractor, with the uncertainty this entails, as well as the actors' differences in process and expectations (Paper II, Paper IV). Design engineers, used to working in iterative early phases, are expected to work together with the contractor on design and project planning, which requires new behaviours as they are co-located.

The *design engineer organisation* must commit individuals to the project for an extended period of time, as well as evaluating their suitability to participate in a CPDM (Paper II). The conversion from allocating employees to many projects at once to one project for a longer time requires internal changes and adaptations on an institutional level (Morris and Geraldi, 2011), as well as the employee-based budgeting design engineers are used to.

The contractor's role behaviour changes especially in early phases, when they take part in early iterations and conceptualisations of the project (Paper IV). This is in contrast with their traditional role of delivering finished works (Eccles, 1981; Hughes and Murdoch, 2003), which caused tension and frustration (Paper II). The behaviour changes relate to both what is seen as work but also the process itself, as the iterative design phase differs from the linear delivery phase contractors are used to (Paper II, Paper III).

The *contractor organisation* must commit high-performing individuals to the project in the early project stages (Paper IV). This might lead to internal conflict as the commercial model for contractors build on turnover rather than hours worked, and many implementations of CPDM lacks reflections on this aspect, especially in early phases.

Table 9: Actor behaviour changes in construction projects (partly adapted from Hughes and Murdoch (2003))

<i>Role</i>	<i>Role description (traditional)</i>	<i>Change</i>
<i>Project management</i>	<p>a) Managing the whole project b) Managing a particular organisation's participation Type of work: Administrative Example of defined roles: Project sponsor; project promoter; project owner; project manager; representative in steering group; collaboration coordinator Time involved in the project: Continuous</p>	<ul style="list-style-type: none"> • The project management needs to cope with managing different skillsets due to the increased need for collaboration capabilities in a CPDM • The project management needs to be able to facilitate the collaboration between client, contractor and design engineer in early project phases in more detail than earlier due to the early involvement employing a CPDM demands
<i>Administration and dispute</i>	<p>Enables day-to-day running of project as well as dispute resolution Type of work: Administrative Example of defined roles: Project administrator; contract administrator; supervising officer; financial planner Time involved in the project: Continuous</p>	<ul style="list-style-type: none"> • The administration needs to cope with managing different skillsets due to the increased need for collaboration capabilities in a CPDM
<i>Design lead</i>	<p>Responsible for co-ordinating part or all of the design; "This is the most important function in the project, involving ascertaining what has to be done and why." (p.151) Type of work: Iterative; administrative Example of defined roles: Design engineer; design lead; architect Time involved in the project: Main contribution in phase 1 (planning and design); supporting role in phase 2 (execution)</p>	<ul style="list-style-type: none"> • The design lead needs to find ways of collaborating with contractors in early project phases • The design lead needs to understand the differing demands from contractor and client • Comfortable working at the project office or sub-project offices, in tight collaboration with contractors
<i>Design</i>	<p>"Designers with specific responsibilities bring many different specialist skills to the process of design. As well as different design disciplines, there are differences in involvement." (p.153) Type of work: Iterative Example of defined roles: Designer; engineer; specialist engineer; landscape architect Time involved in the project: Main contribution in phase 1 (planning and design); supporting role in phase 2 (execution)</p>	<ul style="list-style-type: none"> • Comfortable working at the project office or sub-project offices, in tight collaboration with contractors • Distance to home organisation, especially in phase 1
<i>Contractor's leadership</i>	<p>Procuring necessary resources to carry out the planned design. "In the building sector, it is customary for builders not to take on design responsibility." (p.156) Type of work: Linear; administrative Example of defined roles: Site inspector; lead contractor; block chief; construction manager Time involved in the project: Supporting role in phase 1 (planning and design); main contribution in phase 2 (execution)</p>	<ul style="list-style-type: none"> • The contractor's lead needs to find ways of collaborating with design in early project phases • The contractor's lead needs to understand the iterative nature of phase 1 • Comfortable working at the project office, in tight collaboration with design and client
<i>Contractor</i>	<p>Responsible for carrying out the construction works Type of work: Linear Example of defined roles: Trade contractor; artists; supplier Time involved in the project: Supporting role in phase 1 (planning and design); main contribution in phase 2 (execution)</p>	<ul style="list-style-type: none"> • Comfortable working in tight collaboration with design • Comfortable with not having complete designs from the start
<i>Regulator</i>	<p>Involved in the project by virtue of regulatory and/or supervising functions Type of work: Administrative Example of defined roles: Statutory authorities; health and safety board; local utilities; planning authority Time involved in the project: Occasional activity, depending on client organisation and decision-making mandate</p>	<ul style="list-style-type: none"> • The regulator needs to be comfortable with a certain degree of uncertainty in the project • Responsibility between client-at-project and client-at-home must be clear
<i>Client</i>	<p>Responsible for establishing and defining the project and coordinating delivery. Type of work: Linear Example of defined roles: Sponsor; representative; stakeholder; project manager Time involved in the project: Supporting role in phase 1 (planning and design); main contribution in phase 2 (execution)</p>	<ul style="list-style-type: none"> • Comfortable working at the project office or sub-project offices, in tight collaboration with contractors and design engineers • Distance to home organisation, especially in phase 1 • Comfortable with project-based decision-making

Implementing a CPDM thus changes the project process as well as project roles and behaviour. These changes lead to conflict in the project organisation as actors face a changed reality which does not line up with their expectations. The project set-up becomes especially important, as changes often are met with resistance (Thomas and Hardy, 2011): as the change introduced by the CPDM is a deliberate effort, the conscious set-up of the project becomes especially important for the change to succeed.

6.2.4 A clash of institutions: retreat or development?

6.2.4.1 Institutional change

The interaction of inter-organisational interfaces (Denicol et al., 2021; Jones and Lichtenstein, 2008) increases in complexity the more involved actors there are (Brunet, 2021). The project thus functions as an arena for institutional interaction, as the actors strive to align their practices and develop common norms and rules for the project (Paper IV). The key challenge of coordinating these interfaces (Brunet, 2021; Matinheikki et al., 2019) is compounded by the inherent institutional complexity of such megaprojects (Biesenthal et al., 2018; Söderlund et al., 2017) and the subsequent alignment of competing institutional understandings and logics (Frederiksen et al., 2021; Matinheikki et al., 2019) (Paper V). Thus, projects become an arena for spontaneous development and change of established institutions.

But projects can also be used to intentionally introduce change (Biesenthal et al., 2018), and megaprojects, as society-shaping endeavours, can be said to introduce change by their mere existence (Biesenthal et al., 2018). The studied cases all used CPDM in a conscious effort to change the construction industry, as the client perceived this to be a negative context with less-than-optimal project outcomes. However, the difference in success between the studied cases indicates that the mere application of a new delivery model, such as CPDM, is insufficient to achieve the wished-for results.

Regulative: Introducing new project delivery models change the way projects are delivered. As the client determines the governance structure during pre-project planning, regulative changes are often based on their internal organisational processes and political dynamics. Larger national interests might have a larger, systemic impact, as in case IV where special legislation was passed to enable the project, thus changing the legal environment and giving the client the opportunity to determine goals outside the ‘iron triangle’, such as goals related to social and ecological sustainability, local impact and stakeholder management. The formalised relational approach of a CPDM (Chen et al., 2018; Lahdenperä, 2012) changes the project process due to the requirements of the model (Paper II). Regulative changes can start both from the top down (the client specifies which project delivery model to use) as well as bottom up (projects with a high degree of trust and collaboration seem to be more successful in delivery than traditional projects and the collaborative approach is then adopted as a formal delivery model).

Normative: What is expected and accepted behaviour in projects change with new delivery models, for example from meetings behind locked doors to open meetings inviting project-wide discussion in the co-located space. The actor-specific norms also change, as the co-location and iterative work in especially phase 1 requires new ways of work and new behaviours. CPDM could be argued to allow for the conscious alteration of old norms, such as the open management team meetings in case II, thus using the project as an arena for deliberate institutional change. Normative change is thus both formal and informal, as it is based both on the changes in for example the project organisation (formal) as well as the joint understanding of the right processes to follow.

Cultural-cognitive: The assumptions in a project range from the right way of working to the goals of the project. These understandings are the most individual and thus hardest to capture. They also seem to be the slowest to change. For example, the assumption of what ‘work’ means differed

between the contractor and design engineer, as the former viewed work as a linear process while the latter saw it as iterative. This shaped their interaction and the subsequent conflicts, as seen in case II. As the introduction of CPDM requires behavioural changes, a successful application of the model builds on concerted efforts to align norms, cultures and logics in an early project phase. This dimension of institutional change thus requires special attention and further investigation: is it possible to enact deliberate change without taking the actors' schemas and logics into account?

6.2.4.2 Institutional logic

The project network influences both behaviour and practice in a project (Paper IV). Project networks can thus be conceptualised as an arena for logics to meet and interact through actors (individual and organisational), either by the nature of projects or by intentional project design. Yet homophily is a strong challenge, as interaction is easiest with actors of a similar disposition (McPherson et al., 2001) as discussed in relation to network ties above.

Due to the public-private nature of infrastructure delivery, I view three institutional logics as paramount in explaining the institutional interaction and development within infrastructure megaprojects: *bureaucracy*, comprising the regulative framework, client's political drivers, stated goals and objective; *corporate*, comprising the home organisation's commercial drivers and changed project structure; and *professional*, comprising experience, education, industry and colleagues (Matinheikki et al., 2019; Thornton, 2004) (Paper V). In infrastructure delivery, this focuses mainly on the inter-organisational interaction of client, design engineer and contractor (Eccles, 1981; Hughes and Murdoch, 2003; Kadefors, 1995; Matinheikki et al., 2019). All actors are directly affected by bureaucratic forces such as local legislation and governance structures, as well as market forces and professional codes of conduct institutionalised in the construction industry.

However, the *client*, as a public service procurer, can wield large political power in shaping the project's regulative context through their procurement choices (Denicol et al, 2021; Paper V). As their home organisation in the Nordics is legitimised through public processes rather than market forces, their economic drivers are not strictly market-based, but rather politically motivated. This introduces a certain cyclicity, as they act under the political election cycles. Moreover, they are often restricted by regulations related to openness of public organisations and anti-corruption measures. Professionally, client representatives are often highly educated and belong to professional bodies and unions, shaping their expectations of professional activities and project practices (Paper II). They are not used to intense project participation, which poses a challenge in the CPDM approach.

The *design engineer*, as a service provider, act according to the regulative framework, but they are also directed by the market and their home organisation's position therein (Thornton, 2004). They are, however, often free to cooperate and collaborate with a wider range of actors than for example the client, bound by regulations related to public procurement. Design engineer organisations are mainly corporations and thus follow general market dynamics. Within infrastructure, however, design engineers often work with public clients and are thus also subject to political oscillations. As a profession, design engineers are often highly educated and belong to professional bodies and unions (Paper II). Their work is often fragmented between several projects at once, however, which poses a challenge for full participation in the project-focused approach of CPDM.

The *contractor* must, as a service provider, act according to the regulative framework, but they are also directed by the market and their home organisation's position therein (Thornton, 2004). They are, as the design engineer, often free to cooperate and collaborate with a wider range of actors than the client and their home organisation in general follows market trends. However,

the same political aspects are true for contractors within infrastructure delivery as for design engineers, as they work with the same public client. Professionally, the contractor often have a practical, blue-collar education (L  wstedt and R  is  nen, 2014) and belong to unions (Paper II). Although large contractor organisations can have significant influence from formally white-collar work, such as their own design engineering teams, their identity is still based on the aforementioned practical character and many self-identify as blue-collar workers regardless of educational status or professional role (L  wstedt and R  is  nen, 2014). They are moreover used to work in project-based contexts, enabling the project-focus required by CPDM.

Figure 6 shows the division between public and private (corporate logic), as well as the regulatory framework of the project organisation (bureaucracy) and the actors' professional logics, delineated as white- and blue-collar.

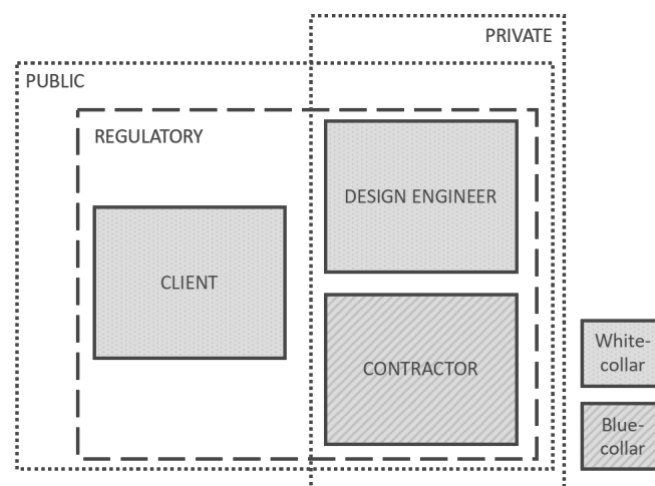


Figure 6: Institutional logics affecting infrastructure delivery

The logics thus first meet in the initial stages of the CPDM, governed by the formal project contract. Ideally, the sought-for relational governance and common institutional understandings and logics emerge from this. However, as Biesenthal et al. (2018) argue, regulative conflicts are easier to solve than normative conflicts, which in turn are easier to solve than cognitive conflicts. The success of the CPDM might thus depend on how logic interaction is managed within the project and how the project network grows: as discussed above, it is easier to create ties with actors similar to oneself –or, on an organisational level, with organisations acting within the same institutional field– and as similar actors have similar logics, this requires a conscious alignment of logics.

6.3 The interaction of CPDM and the infrastructure institution

However, the actors in a project are still affected by their home organisation, contributing to the institutional complexity (Matinheikki et al., 2019; Qiu et al., 2019) in infrastructure delivery and the challenges of aligning logics. The organisations partake in the project through their formal ties, but also include informal ties between individual actors, who can either be fully in the project network (full-time project actors), partly in the project network (part-time project actors; may have specialist knowledge) or completely outside the project network. Paradoxically, CPDM is introduced to mitigate this issue by aligning project participants' views of the project and thus create a cohesive understanding in the project. Successful implementation of CPDM does not merely introduce contractual clauses relating to collaboration but makes the effort for alignment

to occur by constant actor interaction. Cases II, III and IV, for example, exhibited a collective project culture, exemplifying a successful application of CPDM, which was not found in case I (Paper I, IV). Changing norms and behaviours require the right distance from the individual's home organisation as well as the right attitude from both actor levels.

When such alignment does not occur, logics come into conflict. The subsequent incompatible institutional demands and logics affect both the project but also its relationship to the participating organisations, as the actors are influenced both by their role in the project but also by their role outside of it (Paper V). In the project network, the interaction between differing logics is the most frequent within the central project organisation, or the full-time engaged individuals as described above. The part-time project actors occasionally interact with logics different to their own and the actors solely in the home organisation interact with these through the individuals in the project. This moderates the changes as they move from project to home organisation. Figure 7 visualises the differing institutional levels within the project network and their levels of interaction. Those fully in the project interact mainly within the project organisation, while those partly in the project move between the home organisation and project. People in the home organisation are still connected to the project participants through their formal and informal ties, but are not part of the project interaction, thus constituting an anchor to the prevailing institution.

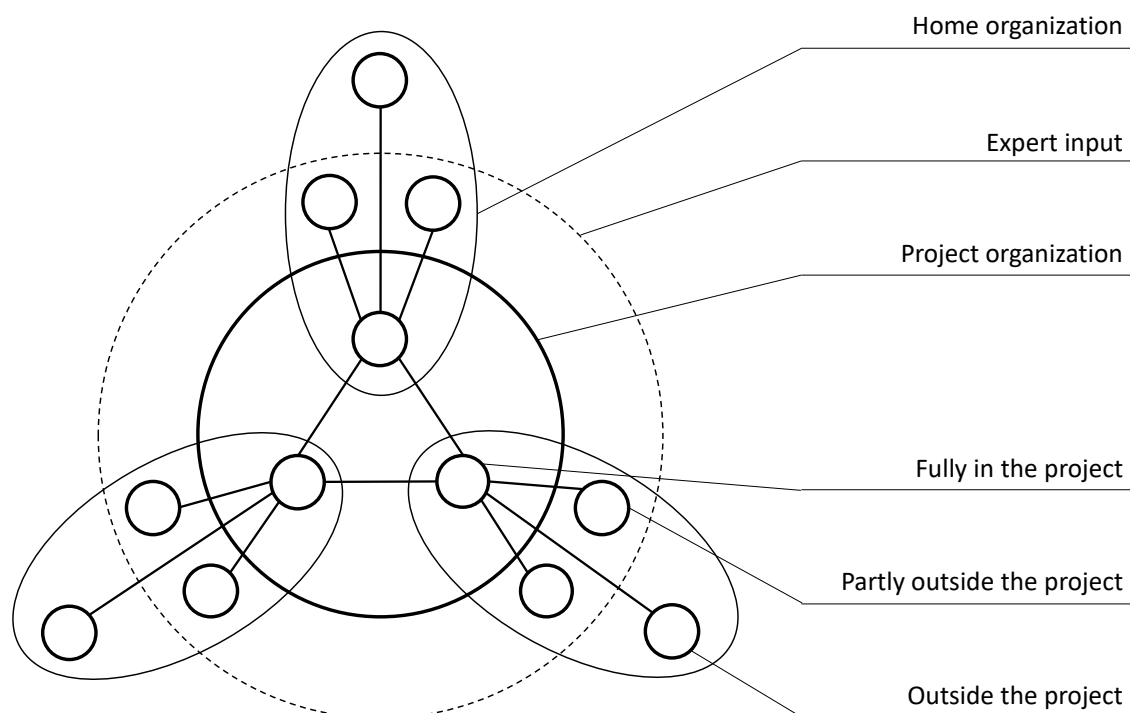


Figure 7: Project dynamics impacting institutional logics in megaprojects (Paper IV)

When actors meet within the project sphere, the view of the relationship comes with an understanding of temporality and the common end goal. This might enable them to be more open to new inputs than they would be in their home organisation, thus easing the interaction of logics. However, it might also cause them to revert to their familiar logics, as they provide a sense of stability (Scott, 2014; Thornton, 2004). In long-term megaprojects, such as infrastructure delivery, this becomes an even more pertinent question as they span decades and thus the need for a common understanding heightens, but the rotation of individual participants requires

constant attention to the interactions taking place within the project as the new entrants bring their home organisation logics with them until they become acquainted with the project specific logics. The different forms of logic interaction –dominance, co-existence and the emergence of new logics (Frederiksen et al., 2021; Gluch and Hellsvik, 2023; Perkmann et al., 2019; Reay and Hinings, 2009; Thornton, 2004)– could be seen in the cases. I argue that this depends on the level of alignment of logics within the project, and that attention must be paid especially to the interaction of similar logics.

The approach to *dominant logics* differs depending on if they are based on actor or dependant on an organisational space (Frederiksen et al., 2021). If they are based on organisational level, differing dominant logics can be benign as they enable for multiple goals to exist simultaneously on different levels in the project, for example on the organisational and individual level (Frederiksen et al., 2021). In this case these would be defined as co-existing on the project level, but dominant on the organisational level. But when dominant logics are based on actors they may pose a threat to project delivery, especially with multiple stakeholders with the same institutional background. The dominance of the larger client and contractor organisation over the smaller in case II, for example, led to resentment and, in the case of the client, to political manoeuvring which slowed down the project. Thus, *dominant logics* may exhibit differently depending on the institutional logics governing the situation. Between commercial organisations, such as contractor firms, the commercial logic prevailed, while in the bureaucratic sphere, the less dominant organisation could use their political power to interfere in the project process, thus illustrating their institutional power.

Co-existence of logics can be beneficial, as, if discussed above, they enable differing goals within the project (Reay and Hinings, 2009). But when they co-exist, as they did in case I, because of an inability to develop new logics on a project level rather than because they are needed to align differing goals, deliberate institutional change through new delivery models such as CPDM cannot take place. The different spheres of the project (administration, design work, delivery) were thus governed by co-existing, yet traditional, logics, already established in the industry. This made it easier for new entrants into the project, as they knew what to expect, but it also became a barrier for the intended institutional change the client had envisioned when they decided on the CPDM. The participants also mentioned good collaboration within their home organisation and specific part of the project (or network cluster), but challenges when working in the larger project network, illustrating conflicting logics on a project level. This leads to conflict and even stronger retrenchment in existent logics. Thus, *co-existence of logics* on a project level may ease collaboration within the clusters, but act as a barrier to inter-cluster collaboration on the project level.

New logics require the right normative environment to facilitate the initial period of ambiguity and uncertainty (Gluch and Hellsvik, 2023; Matinheikki et al., 2019; Reay and Hinings, 2009; Thornton et al., 2012). For example, cases II, III and IV exhibited a conscious effort to promote social interaction and create frameworks for informal ties to form: although they all included mentions of collaboration in their contracts and stated a wish to act according to a CPDM mentality, the commitment to creating a common culture from the initial project stages enabled the creation of strong ties through constant interaction and well-established project processes. On an individual level, respondents from all three cases also reflected on the ongoing efforts to understand other actors from different backgrounds and the need for a collaborative mindset from participants. Thus, the *emergence of new logics* requires conscious, continuous effort and resources in addition to a contractual framework and a project which enables the interaction of current logics.

7 CONCLUDING REMARKS

The changing project environment in infrastructure delivery and application of CPDM introduces new processes, roles and norms. A multi-level view is necessary to understand the network dynamics shaping the ongoing institutional change. Different network ties influence the project in distinctive ways during the process, depending on the project level (organisational, project, individual).

CPDM was introduced with the desire to change the institution of infrastructure delivery. This has four main implications. First, the rise of relational governance changes the formal framework of construction projects as contracts, imperfect at the best of times, get complemented by trust and social ties. Relational governance, as seen in the increasing use of CPDM in infrastructure delivery, is enabled by initial setup and project identification, resource sharing, shared space, and expectations of actors' roles, among other factors. The changing formal framework introduces changes in the project network as the structure becomes more cohesive and new facilitators and boundary spanners emerge. As argued above, the whole project changes: process, roles and behaviours all have to develop to meet the requirements of a CPDM. However, this requires a multi-level view of the project. The individual is tied to their home organisation through their employment contract and the organisation to the project through their project-specific contract, as discussed in paper I. However, as Figure 7 shows, the interaction of the organisational plane and the individual performing the work within the project organisation necessitates a wider understanding and conceptualisation of what a project is and who partakes in it. I argue that the project network created between the individual actors through their social ties enables inter-organisational collaboration.

Second, current research, while paying well-deserved attention to the increased importance of social ties, has overlooked emergent challenges, such as the difficulties of introducing new actors to the network as well as clashing institutional logics. The network focus requires a renewed look at the concept of 'collaboration' and how long-term projects are managed when using a CPDM. Not discounting the benefits of the model, the risks of strong ties are nevertheless underexplored in literature. As shown in paper III, the challenges include barriers to entry into the social network and a weakened link to the individual's home organisation.

Third, the project exists in the nexus of several actors, namely: the client, the design engineer and the contractor. As stated in the beginning, the subcontractor ecosystem is outside the scope of this thesis. These actors are influenced by institutional logics, namely: bureaucratic, corporate and professional logics. The project network thus functions as an arena for institutional interaction between actors, which can lead to tensions within the project, as discussed in paper IV. However, not all projects manage to birth new logics. I argue that in order to do so, the project needs to achieve true collaboration and a cohesive project network which enables information exchange and trust-building.

Fourth, combining institutional theory and network theory can provide new avenues for theoretical development. The qualitative approach taken with respect to networks deepens our understanding of network characteristics and the drivers of ties formation. Moreover, the discussion on tie characteristics and their relation to how institutional logics affect the network creation between project actors helps develop the discussion on institutional logics and provides novel insights into institutional development.

The success -or failure- of a project using a CPDM might therefore depend on the interaction of institutions within the project network and how differing logics are managed in the organisation. This shift may lead to industry-wide changes as project actors become used to collaborative, trusting ways of work and expectations align. The initial project set-up and formal

ties in the beginning of the long-term project plays a crucial role in setting the stage for informal ties and cohesive networks to develop, but require the right resources in order to do so.

7.1 Answering the research questions

With a theoretical framework combining social network theory and perspectives on institutional logics, this thesis has sought to investigate the phenomenon of CPDM in infrastructure delivery projects and analyse changes introduced thereby for project actors in order to develop a deeper understanding of how the CPDM approach is used in practice.

The first research question, *How do social network dynamics explain the implementation of CPDM in the delivery phase of infrastructure projects*, focuses on social network theory. To answer this question, I focus on project networks and their structure, actors and ties, as well as the challenges posed by the sought-for cohesive networks with strong ties.

Project networks arise in projects by the interaction of the actors involved. Their existence can thus be managed but not prevented. As they create the framework for actors, ties and structure, their management becomes paramount in a CPDM environment. The *structure* within the network can either hinder or enable resource flows and thus become interesting depending on the intentions for the project. To avoid bridging and support cohesive networks, the focus is on enabling informal social interactions within the project. The project network is shaped by –and shapes in turn– the project setup, resource sharing, co-location and project expectations.

How *network actors* are viewed depends on the level of study: on an organisational level, the discussion centres mainly on organisational characteristics and industry-level logics, such as corporate forces, while on an individual level, the focus is on individual drivers and individual-level logics, such as professional identification. The ties connecting actors, be they strong or weak, are also dependent on the level of investigation. On an organisational level they are mainly formal, such as contracts and business relations, while the discussion on an individual level can encompass both formal ties to their home organisation or the project, as well as informal social ties to other individuals. In practice, the organisations enable the social ties to form between individuals through their application and understanding of the contract. However, the individuals also enact their understanding through their actions within the project, thus realising the contract. Thus, the social network influences the application of a CPDM through the ties created within the project network.

However, the strong social ties sought for in a CPDM have their *challenge* and ‘dark side’ as they can exclude actors from the project network to the detriment of long-term megaprojects. Moreover, they can act as a barrier for new resources and knowledge as well as the development of project logics as the in-group formed in a CPDM may exclude ideas from ‘the outside’.

Thus, social dynamics can explain the successful implementation of CPDM in the delivery phase when taking a holistic view of the network and including both formal and informal ties, although the structure of the project network may hinder the introduction of new actors and resources if it is too cohesive.

The second research question, *How does using a CPDM impact project delivery*, focuses on the phenomenon, its governing institutions and the effect on project actors. CPDM represents a conscious change effort by the client organisation requesting the model to be used in infrastructure delivery. The client is subject to the largest change when engaged in a CPDM, although design engineers and contractors also must adjust somewhat.

Delving into this process, this thesis shows how processes, roles and behaviours change within a project utilising a CPDM by relying on relational governance rather than merely contracts. I have also shown how these changes are realised as changed roles and behaviours, as well as the

practical process adjustments necessary. Moreover, the findings show how the contract shapes the framework for the relational aspects to form through social interaction. When a CPDM is applied with a suitable contractual framework, it can introduce new ways of work to the actors, thus broadening their skill set and enabling inter-organisational collaboration and knowledge exchange. There are furthermore new behaviours and processes emerging, while existent ones might not be as necessary as previously thought.

An institutional lens has enabled a multi-level view of involved actors, focusing on the individual, project and home organisation. The interaction of both actors and levels of analysis is evident in the emerging multi-faceted view of projects, encompassing dynamics between individual and organisational levels as well as within the project and between the project proper and involved organisations.

Thus, using a CPDM can enable quicker resource flows and changes of processes, roles and behaviours in the project when using a suitable contractual framework.

The third research question, *How does using a CPDM influence the interaction between the project network and its institutional environment*, relates to the interaction of projects, institutions and institutional logics. The project network can either enable or hinder the alignment of different institutions, depending on the network structure and the flows it facilitates. The institutionally minimised interaction of logics within a construction project, traditionally divided into iterative design and linear delivery, is deliberately changed by the introduction of CPDM and social interaction required thereby. The institutional changes relate both to regulations and legislation, norms and cultural-cognitive aspects, as new contracts and standards are introduced, project processes are planned with a novel organisation in mind and assumptions grow through informal interaction. As the project acts as an arena for institutional interaction, the possibility of conflict is present due to differing logics. This can, however, be beneficial for the project depending on the level. On an organisational level, conflicting logics can enable the simultaneous co-existence of several goals. On an individual level, differing logics can lead to conflict as these interactions often happen on the same organisational level, the risk of fragmentation and clustering within the project network grows. When a project organisation is sufficiently prepared and acceptant of the intended change, the project can act as a nexus for existent institutions to interact and support the emergence of new ways of work and thought, based on the requirements of the applied governance model. Thus, using a CPDM can enable the interaction of differing institutions, institutional change and the development of new institutional logics if the project network and tie dynamics support this.

7.2 Contributions

By answering the research questions, this thesis provides insights into a novel phenomenon. The network view helps add context to project organisations, while the institutional perspective grounds the project in a specific institutional context, adding nuance and depth to the discussion on changes brought forth by CPDM.

7.2.1 Theory

With respect to project networks, the work expands on using qualitative methods in working with networks and a focus on the characteristics of ties rather than nodes. This broadens the network literature by developing the ideas about formal and informal ties, as well as the interaction of relational and contractual frameworks. The contribution of the network approach taken in this work centres on the importance of tie characteristics: as much research has focused on actor (node) characteristics, this project continues expanding on the call for further insight into the characteristics of ties. Furthermore, the proposed mechanics behind network structure and the

weakness of strong ties give deeper insight into network dynamics as well as the interaction of different ties on different levels of the project.

With respect to institutional theory, the work provides an application of institutional theory to an empirical context through the discussion on institutional logics in the construction industry, as well as insight into changing institutional settings. The contribution of the institutional logics perspective is based on first the empirical evidence of projects acting as a nexus for institutional logics to meet and interact, thus enabling the emergence of new logics – or the return to traditional, familiar logics when the change is misaligned with project and actor goals. Second, the work gives empirical evidence for the change process happening as a new governance model (CPDM) is introduced into a highly institutionalised industry (construction).

With respect to project management and the growing body of megaproject literature, this research contributes to a deeper understanding of project dynamics and organisation. It provides empirical evidence of the interaction of different project levels and the project as an arena for institutional interaction, thus supporting further theorising regarding project organising and megaproject delivery.

On a general level, the novelty of combining network theory and institutional theory, showing how networks shape institutional change and how institutions affect networks, helps conceptualise projects as what they are: temporal melting pots, where actors meet, exchange ideas and develop.

7.2.2 Practice

For practitioners, the work contributes on three main fronts. First, it provides insight into how collaboration is viewed and defined in the construction industry as well as highlighting the need for further clarity in this matter. Since this is a central tenet of CPDM, an increasingly popular project delivery model, clarifying this central concept would advance the industry. Second, the work shows several challenges with implementing CPDM, such as the difficulty of introducing new actors to the network created within. Third, I include the design engineer in the discussion, a hitherto ignored actor. Finally, it provides insight into the changing project process, highlighting the need to adapt roles, requirements and resources to the changing reality of CPDM.

7.3 Suggestions for future research

Although I add new insight about project networks and the change brought by relational governance and the use of CPDM, several areas remain understudied. An obvious starting point is in extending this research into fields outside construction, such as ICT or healthcare. Another possibility would be to investigate CPDM in construction outside the European Union and the United Kingdom.

Another area relates to qualitative network changes throughout the project process. In this work, I make pitstops at several projects. Future research could take a longitudinal perspective of one project and see how the network develops within.

The findings show role changes and emergent roles but leaves practices and processes aside. Investigating the relationship between changing practices and role change, as well as changing project processes when the project structure and actor roles change would clarify the matter.

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